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Short title: Comparing constructicons

Comparing constructicons:

A usage-based analysis of the causative construction with *doen* in Netherlandic and Belgian Dutch[1]

Abstract

In the constructionist view, the grammar of a language is represented by constructions organized in taxonomic networks. This paper addresses the question of how one should account for the differences and similarities in the organization of such networks in different varieties of a language. In particular, a corpus-driven quantitative methodology is developed that can provide evidence for modelling the relevant constructional networks. The method is based on hierarchical cluster analysis applied to multivariable data, and several statistical criteria of cluster stability. These points are demonstrated by means of a corpus study of the Netherlandic and Belgian variants of the Dutch causative construction with *doen* "do". The paper describes the national differences in the structure of the constructicon and interprets them from a usage-based historical perspective.

Keywords: causative construction, Dutch, language variation, hierarchical cluster analysis, constructicon, language change, constructional schema

1. Introduction

Constructions are organized in taxonomic networks, which represent the speaker's knowledge of the

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language and grammar. An example of a constructional taxonomy is the relationship between the superordinate ditransitive construction V+ NP + NP[2] and its subordinate *give* + NP + NP. According to the usage-based versions of construction grammar by Langacker (1987), Goldberg (1995; 2006) and Croft (2001), constructional taxonomies are learnt by the speaker in a bottom-up way: abstract schemata emerge on the basis of specific exemplars. The qualitative and quantitative characteristics of the constructional input play a crucial role in this inductive learning process. Obviously, there are unavoidable differences in the input between even very closely related language communities. It follows from this that constructions are subject to change and variation, and so are constructional taxonomies, which constitute constructicon – a term coined by Jurafsky (e.g. 1996) to refer to the lexico-syntactic continuum that represents the grammar of a language. This kind of variation should be taken into account in usage-based construction grammar, yet, surprisingly, this problem has hardly ever been addressed. The present paper proposes a way to deal with this kind of variation, and offers a corpus-based methodology that allows one to model the general and variety-specific constructional networks of a language.

This approach is demonstrated by means of a case study of the taxonomic network of the Dutch causative construction with *doen* "do" in the Netherlandic and Belgian varieties of Dutch. For example:

(1) *Haar stem deed het glas barsten.*
her voice did the glass break
"Her voice caused the glass to break."

Previous studies of *doen* usually compared its use to that of *laten* "let", the other periphrastic causative in Dutch (e.g. Verhagen and Kemmer 1997; Degand 2001; Levshina 2011). There have also been several analyses of the causative *doen* on its own (Stukker 2005; Levshina 2011; Levshina

2 The symbols NP, V and others are used without assuming an autonomous syntactic level.

et al. 2011). The present study assumes that constructions are symbolic entities that can and should be studied independently (Goldberg 2002; Colleman 2010), although the interconstructional perspective may add important details. More specifically, this paper compares the networks of *doen* in the Netherlandic and Belgian varieties of Dutch: their general organization and specific schemata.

However, before exploring the networks, we should answer the questions of what the nodes in a network should look like and what conditions should be satisfied for them to be stored in the speaker's mind. This paper follows Verhagen's (2009) view of constructions as complex signs. That is, constructions can be stored even if they are not lexically specific. Such schemata can perform a signalling function, serving as indices (symptoms) and triggering particular interpretations. The second question, which constructions are stored and which are not, is answered within the usage-based non-reductionist framework (e.g. Langacker 2005) in the following way: a construction is posited when it occurs with sufficient frequency. However, this approach does not solve the problem entirely. When learning constructions, the speaker encounters a multitude of linguistic and other clues. Potentially, all this information can be constructions, as, for instance, in the case of any highly frequent bigrams, e.g. “a bad” (16 244 occurrences in the Corpus of Contemporary American English, case-insensitive) and “that of” (25 024 occurrences). But these highly frequent collocations do not look meaningful. So, how is all this information organized? An answer can come from multivariate psychological studies of categorization (see Murphy 2002). Natural language categories tend to display a set of correlated features (e.g. birds have wings, can fly and make nests in trees), which occur together more frequently than one could expect from pure chance. Our minds are sensitive to such correlations. Therefore, constructions should be identified as 'bunches' of correlated semantic, formal and pragmatic features at different levels of abstraction.

The question is then, how to find these 'bunches' of features empirically? This paper presents a novel bottom-up quantitative model of hierarchical networks based on hierarchical cluster analysis of corpus data, which allows for fulfilling the above-mentioned desiderata. The clusters of exemplars represent possible schemata at different levels of abstractness and share a set of correlated semantic and formal features. However, a corpus-based study can examine only a limited data set. It is important then to check which clusters can be representative of the actual language behaviour and the entire population of utterances, and which probably emerged by chance. This is operationalized as the stability of clusters in the clustering solution, which is determined with the help of several bootstrapping procedures. The stability can be interpreted in terms of entrenchment and distinctiveness (autonomy) of the corresponding subconstructions in the constructicon of an average speaker. The comparison of the Netherlandic and Belgian networks of *doen* is then a comparison of the region-specific clustering solutions.

The rest of the paper is organized as follows: The construction under consideration is discussed in Section 2, followed by a description of the data and methodology in Section 3. Section 4 presents the results, which are discussed and interpreted in Section 5. The conclusions are presented in Section 6.

2. The Dutch causative construction with *doen*: Formal, semantic and lectal[3] variation

2.1. The formal and semantic variation

The causative construction with *doen* consists of several slots. Consider again the previous example, repeated here for convenience:

(2) *Haar stem deed het glas barsten.*

3 The term 'lectal' is an umbrella term, which is related to any kind of *lect* (language variety): dialect, sociolect, regiolect, etc.

her voice	did	the glass	break	
Causer	**Causative Auxiliary**	**Causee**	**Effected Predicate**	

"Her voice caused the glass to break."

The verb *doen* itself (the Causative Auxiliary) represents a schematic causing event. The other verbal slot is the Effected Predicate, an infinitive that specifies the effected (caused) event (*barsten* "break"). The other important slots are the Causer, the entity that initiates the causation, as *haar stem* "her voice" in the example, and the Causee – the entity that performs the effected event (*het glas* "the glass").

The formal variation manifests itself in the explicitness or implicitness of the constructional slots and in the lexical-semantic realization of the components. This variation is accompanied by semantic and pragmatic differences between the formal variants. For instance, it is quite common to omit the Causee, especially in contexts with mental and/or transitive Effected Predicates:

(3) *Het doet het ergste vermoeden.*

it does the worst suspect

"It makes [one] suspect the worst."

As Goldberg (2005) shows in her discussion of implicit objects of transitive verbs, there exist a number of cultural and semantic reasons for omission of constructional slots – from taboo to generic use of the construction. The omission thus should be functionally motivated. In contexts like (3) the implicit Causee plays a peripheral role. The Causer *Het* "it", an event or a situation, automatically triggers the expectation, whoever the cognizer might be. An additional factor might be avoidance of first-person reference in accordance with social norms.

Another kind of formal variation concerns the number of potentially available slots. The Effected Predicate can be transitive or intransitive, like *vermoeden* and *barsten*, respectively, in the examples above, although the transitives are relatively infrequent. The direct (or, in the absense thereof, indirect or prepositional) object of the Effected Predicate is called the Affectee. This third participant is the energy 'sink' of the causation flow. The configuration of the participants iconically represents the causation chain and evokes specific semantic roles of the participants (see Kemmer and Verhagen 1994 for more details).

In general, the construction is believed to refer to (more) direct causation, in comparison to its counterpart – the construction with *laten* "let", which denotes more indirect causation. According to Verhagen and Kemmer (1997), (in)directness of causation reflects which entity plays the more immediate role in bringing about the result: the Causer (direct causation) or another participant – most commonly, the Causee (indirect causation). Semanticists also distinguish four more specific causation types, which are typically construed either as direct or indirect causation. The two types that are normally construed as direct causation and tend to be coded with *doen* are physical and affective causation. Physical causation normally involves an inanimate Causer and Causee, as in (2) above. Affective causation, exemplified by (3), denotes a stimulus (usually an inanimate noun or pronoun) that triggers a mental reaction of an animate cognizer. The two remaining types of causation that are discussed in the literature – volitional and inducive causation – are less typical of *doen*, especially the latter (Verhagen and Kemmer 1997).

Physical and affective causation can be seen as the semantic contents of the corresponding formal patterns with the coarse-grained semantic classes of the slot-fillers. There are also plenty of more lexically and semantically specific constructions. Probably the most common collocation is *doen denken aan* "remind of" (lit. "make think of"), which is an example of affective causation:

(4) *Deze film doet denken aan Fellini.*

this film does think to Fellini

"This film reminds [one] of Fellini."

Other frequent expressions with *doen* are *iemand iets doen opmerken* "draw someone's attention to something", *iemand naar iets doen verlangen* "make someone crave for something", *van zich doen spreken* "make one's mark" (lit. "make people talk about oneself"), *iemand iets doen toekomen* "send someone something", *hoop doet leven* "while there is life there is hope" (lit. "hope makes (one) live"). There are quite a few metaphorical idiomatic expressions, e.g. *een belletje doen rinkelen* "ring a bell, be familiar" and *het tij doen keren* "turn the tide". In the current usage-based constructionist approaches it is believed that both the idiomatic expressions, whose meaning is motivated by but not predicted from their components, and semantically transparent collocations should be stored if they are highly frequent (see Langacker 2005; Goldberg 2006). However, the extent to which the meaning of the seemingly transparent expressions is *actually* predictable is an empirical question. As we shall see in the discussion of the expression *doen denken aan* below, highly frequent 'transparent' constructions do exhibit interesting semantic idiosyncrasies.

2.2. Lectal variation

The construction exhibits substantial lectal variation, as well. It is significantly more frequent in Belgian Dutch and in more formal registers (Levshina 2011). A logistic regression analysis of a large data set (Levshina 2011) shows that the geographical variety significantly influences the speaker's choice between *doen* and *laten*, other parameters being constant. More specifically, Belgian speakers do not shun the use of *doen* as much as the Netherlandic ones do. Some studies also indicate qualitative differences. A distinctive collexeme analysis of the main slots of the construction with *doen* in Netherlandic and Belgian Dutch (Levshina et al. 2011) shows that the

Netherlandic variant is more frequently used to refer to affective causation ("changing the mind") than its Belgian counterpart, which is also frequently used to denote other types of causation ("changing the world"). Some more specific lexical patterns are pragmatically marked, as well. For instance, *iemand iets doen toekomen* "send someone something" usually refers to official documents and therefore normally occurs in formal discourse. Another formal pattern is *iemand iets doen weten* "inform somebody about something", which is also very archaic (an unmarked alternative in contemporary Dutch is the variant with *laten*). However, the question as to whether there are lectal differences in the structure of the constructional network of *doen* has not been addressed yet. The present study explores this issue with regard to the geographic variation of Netherlandic and Belgian Dutch.

3. Data and method

This study is based on two samples of the causative *doen* from several Netherlandic and Belgian corpora that represent three registers of communication of varying degrees of formality:

- spontaneous informal face-to-face conversations from the lemmatized and part-of-speech tagged Corpus of Spoken Dutch (Oostdijk 2002);
- raw-text online postings in the Usenet discussion groups, currently located at groups.google.com[4];
- newspaper language from the morphologically and syntactically parsed Twente News Corpus (Ordelman et al. 2007) and Leuven News Corpus[5].

4 The author gratefully acknowledges the help of Tom Ruette (University of Leuven) in data collection.
5 The author thanks the Quantitative Lexicology and Variational Linguistics research unit at the University of Leuven for providing the data. I used an XML parser written by Kris Heylen and Dirk Speelman to work with the newspaper corpora.

The observations were collected automatically, with the help of regular expressions and Python scripts, which took into account the lemmata, part-of-speech tags, and syntactic information, where available. The results were manually checked, to avoid spurious hits, such as the periphrastic and habitual uses of *doen*, which are common in some substandard varieties of Dutch (e.g. Cornips 1998). Because the construction is very rare in spoken Netherlandic Dutch (only 22 instances found in the subcorpus of 1,7M tokens), the samples were relatively small, 22 exemplars per register by geographic variety. The observations were selected randomly from a larger pool of examples found in the above-mentioned corpora. In total, each variety was represented by 22*3 = 66 exemplars, which means that the total number of exemplars was 132.

The exemplars were then coded for 35 features. These variables can be subdivided into several groups:

- variables related to the nominal slot fillers (the Causer, the Causee and the Affectee, if available): the semantic class, syntactic expression, part of speech, grammatical person, number and definiteness;
- specific features of the Causee: volitionality and whether the participant undergoes or causes a change;
- variables describing the relationships between the main participants: relationships of coreferentiality and possession;
- features of the Effected Predicate: transitivity (in a broad sense, including ditransitivity, copula functions, etc.), and the type of prepositional complements. Also, the semantics of the caused event was considered, both in the literal and metaphorical sense (if applicable). The specific lemmata of the predicates were considered a separate variable, as well, because many of them occurred more than once;

- variables related to different modifiers: polarity (negation), adverbial modifiers, modal verbs;
- the syntactic function of the construction (predicative, nominal or adverbial, e.g. in non-finite clauses of purpose);
- more general properties of the clauses and sentences where the construction was found, such as the mood and tense of the clause, the syntactic type of the clause (main, relative, adverbial, etc.), and the communicative type of the sentence.

This list of variables represents the possible contextual variables that could be described at an acceptable level of objectivity, with the help of available linguistic markers and contextual clues. If the contextual information was insufficient, the feature was coded as 'Not Applicable' (e.g. the grammatical properties of the missing Affectee). This comprehensive approach is similar to the one in Gries' (2006) corpus-based analysis of the verb *run*, which also involved a large number of heterogeneous variables. Although many of these variables are associated, such redundancy of linguistic clues is natural when we learn a new word or construction.

Next, the matrix with the rows as observations and semantic variables as columns was transformed into a matrix of distances between the observations with the help of Gower's (1971) distance, which is suitable for categorical and mixed data. The distance is implemented in the `daisy` function from the `cluster` library in R (R Development Core Team 2011). The calculations are based on a very simple principle: the more features are shared by a pair of observations, the higher the similarity score between the two exemplars, and consequently the smaller the distance between them.

A matrix of distances can serve as input for cluster analysis, multidimensional scaling and other techniques for analysis of multivariate data. In this case study I apply hierarchical agglomerative clustering, which is particularly suitable for representing hierarchically organized networks. The term 'agglomerative' means that the clusters (generalizations) emerge from the bottom up. In the beginning of the analysis, every object (in this case, every exemplar) in the distance matrix forms its own cluster. Next, the algorithm joins the two objects with the minimal distance (and therefore the maximum similarity) between them, and then proceeds iteratively, joining objects and small clusters until they all form a single megacluster (the 'root'). The analysis can be represented as a dendrogram with 'branches' and 'leaves'. There are several clustering methods, which differ in the way the leaves are amalgamated into clusters (Everitt et al. 2001). In this study I used the popular Ward's minimum variance method, implemented in the `hclust` function in R, which allows for identification of small and interpretable clusters.

The resulting solution can be interpreted as a possible model of the speaker's knowledge of the specific part of the constructicon. It allows for the representation of both individual exemplars, low-level generalizations and higher-level schemata. It is not assumed, of course, that an average speaker of Dutch stores exactly the same exemplars as those found in the corpus. But, provided the corpus is representative enough, the generalizations over the exemplars, represented as clusters, should be valid. However, the validity should also be tested statistically. We should be sure that the clusters that were detected are stable and will not disappear if the data set is changed in a non-essential way (see Hennig 2007 for a discussion). In this paper, we apply a widely used bootstrapping approach. It is based on many random samples from the data. Every sample is subjected again to the cluster analysis procedure. If the structure of the cluster in the original clustering solution remains the same or similar over many iterations, one has reasons to believe that the cluster is stable. We employed a modified version of the `clusterboot` function in the `fpc` package developed by Hennig (2007). Three different bootstrap sampling procedures were used:

a. Random sampling from the original 66 observations with replacement, when an observation could be used more than once in a sample. A physical analogy would be taking a marble from a bag with 66 different marbles, putting it back and repeating the procedure 66 times. This algorithm is

implemented in Hennig's function and involves a non-substantial change of the original data;
b. Random sampling from the original 66 plus an additional 33 (½ of the original number) observations, so that the original observations are 66.6% of the entire sampling pool (66 from 99). The latter were selected randomly from additional instances of *doen* found in the newspaper and Usenet data. The sampling was without replacement – in other words, the marbles were not put back into the bag;
c. Random sampling from the original 66 plus an additional 66 observations, so that the original observations are only half of the total sampling pool (66 from 132), which means a substantial change in the data. The latter were selected randomly from additional instances of *doen* found in the newspaper and Usenet data. The sampling was without replacement.

The metric chosen to evaluate the stability of a cluster is the Jaccard similarity coefficient, which shows how similar a cluster in the original solution (Cluster A) is to its most similar cluster produced in the given bootstrapping iteration (Cluster B). More precisely, the metric is a proportion of the number of the exemplars that belong to both Clusters A and B, of all the exemplars involved in at least one of the clusters. The greater the proportion, the more similar Cluster B is to the original Cluster A. After the full bootstrapping cycle with a user-defined number of iterations *n*, the program computes the average Jaccard coefficient for every cluster from the similarity values in all *n* iterations. The number of iterations *n* in our analyses was 100 (the default and recommended value). The observations from the bootstrapping samples that did not occur in the original data set (see procedures a and b) were excluded from the calculations of cluster similarity.

4. Results

4.1. The Netherlandic network

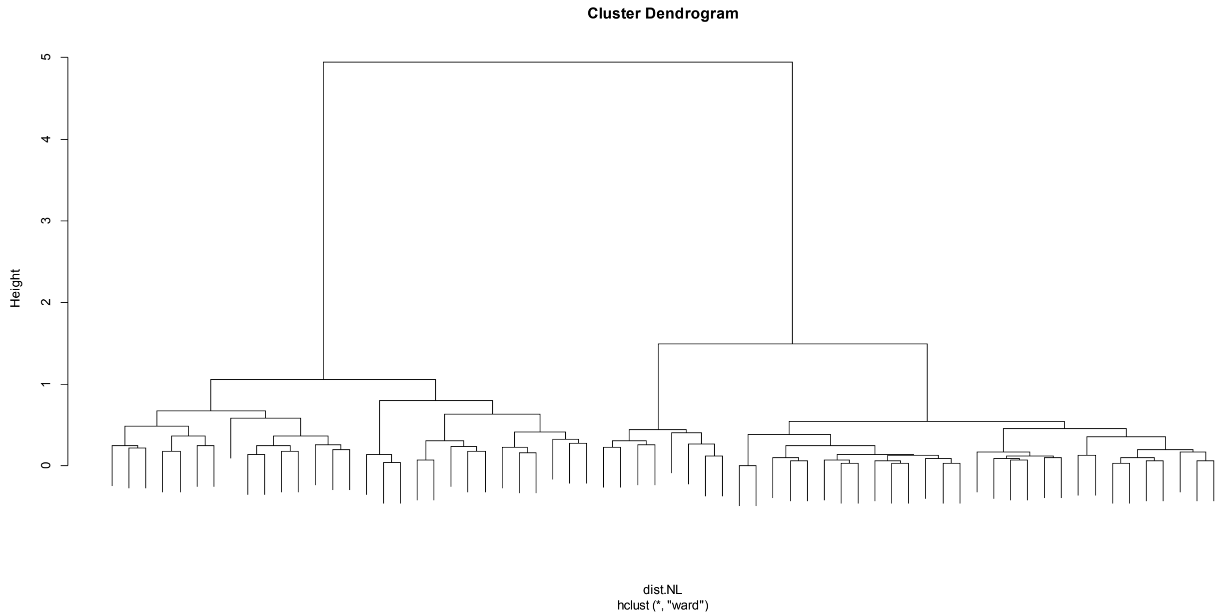

Figure 1. Hierarchical cluster analysis (Ward's algorithm) of *doen* in Netherlandic Dutch.

The 66 observations from the Netherlandic corpora were clustered with the help of the hierarchical clustering algorithm. The resulting dendrogram is shown in Figure 1. In total, there are 65 clusters of different size, which amalgamate at different heights of the dendrogram. Which of these 65 clusters have a chance of being a part of the speakers' constructicon provided that the corpus sample is close to the actual linguistic input of an average speaker? Using the bootstrapping technique described in the previous section, I obtained the average Jaccard coefficients for all clusters in the dendrogram. Figure 2 shows the clusters outlined with rectangles. The outlines correspond to the stability values.

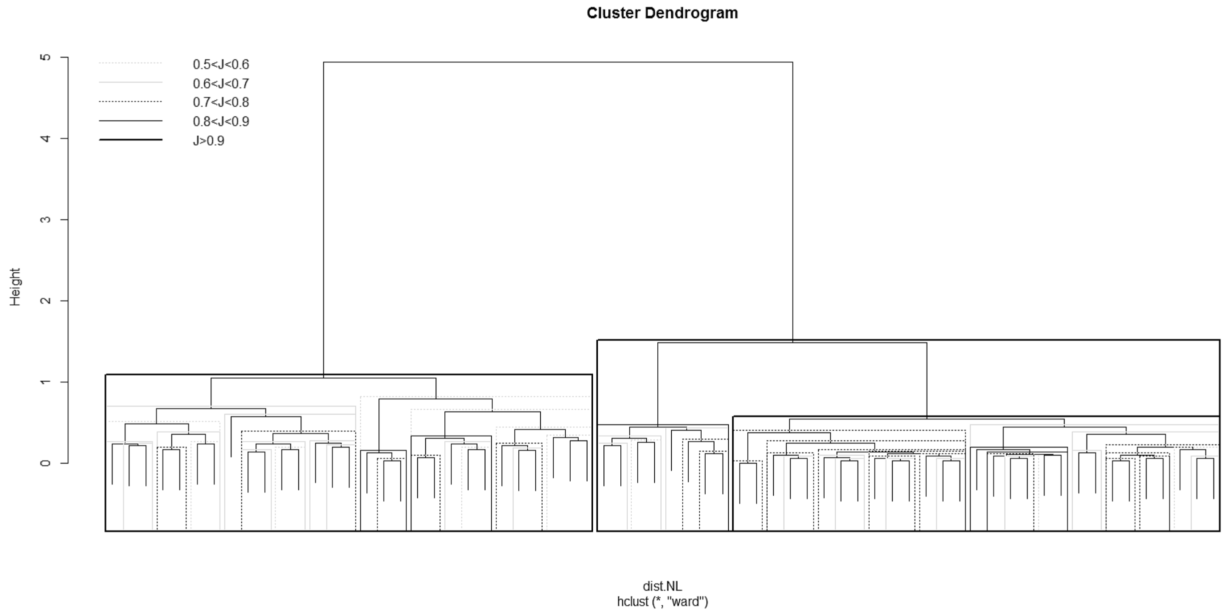

Figure 2. Hierarchical cluster dendrogram of the Netherlandic data with the stability values after the bootstrap with replacement (n = 100). The outlines of the rectangles correspond to the Jaccard coefficient values (see the legend).

Figure 3 shows the selected clusters with Jaccard coefficient above 0.8 (inclusive). In the two other sampling approaches without replacement with 33 or 66 additional points from the corpora, these clusters were found to be stable or highly stable, with the exception of Cluster 7, which had the coefficient slightly below the cut-off point (0.79) in the sampling with 66 additional points.

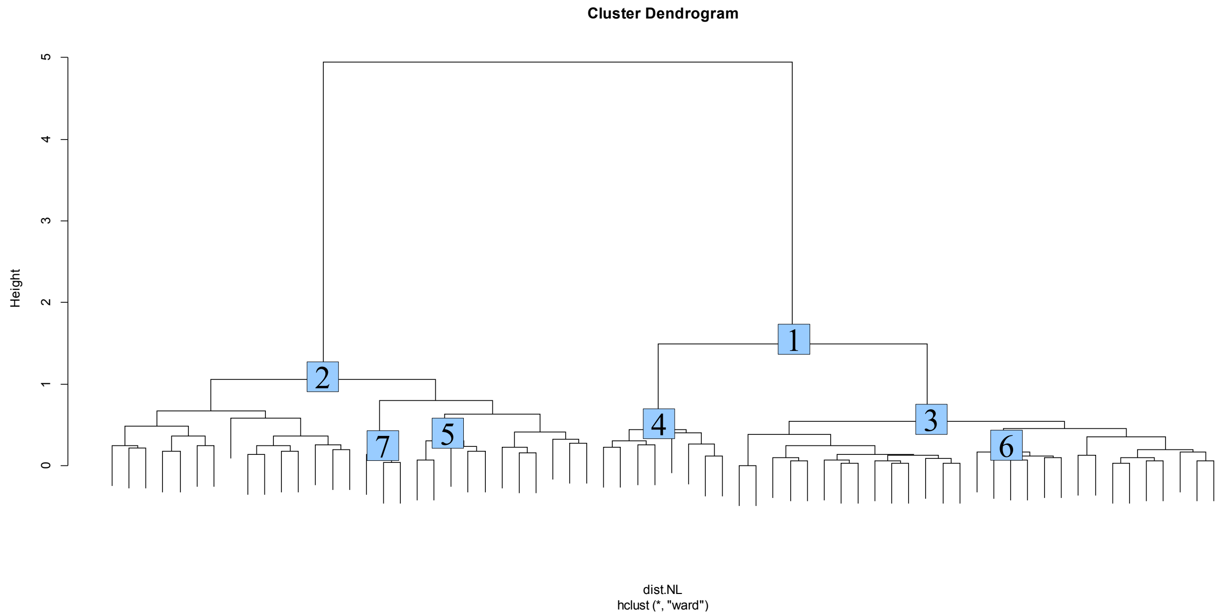

Figure 3. The most stable clusters (J ≥ 0.8) in the Netherlandic solution according to bootstrapping with replacement.

One can see that the top-level large clusters (1 and 2, as well as 3 and 4, which compose Cluster 1) are stable, as well as a few smaller local clusters (5, 6[6] and 7), which are embedded in the larger ones. The next step is to interpret the clusters from the semantic point of view. There are two ways of doing that. On the one hand, we can focus on the features shared by the members of a cluster. Since one can treat the stable clusters as constructions, they can be studied on their own (Goldberg 2002; Colleman 2010). On the other hand, we can describe the differences between the clusters, as it was done, for instance, in Divjak and Gries (2006). In their study Divjak and Gries compared non-overlapping clusters of several Russian verbs. In our case, the solution also contains embedded clusters, which probably inherit some of the semantic properties from their 'parents'. Ideally, all these horizontal and vertical semantic relationships should be explored. Due to space limitations, however, I will focus mainly on the most common intracluster features.

Table 1 shows the features that are shared by more than 90% of observations in each of the clusters.

6 Note that Cluster 6 contains another stable cluster, which contains all members of Cluster 6 but one. Unlike the members of the embedded cluster, which have abstract Causers, this observation contains a human Causer. The other features are shared in a family resemblance fashion.

Cluster	The most frequent within-cluster features
1	indicative mood, declarative sentence, predicative function of *doen*, no modals, no coreferentiality or possession relations, no negation, mental caused event (lit. and fig.), 3rd Pers. Sg. Cr, human Ce, 3rd Pers. Aff
2	indicative mood, declarative sentence, predicative function of *doen*, no modals, no coreferentiality or possession relations, no negation, non-volitional Ce, 3rd Pers. definite Cr, intransitive EP without PP complements
3	indicative mood, declarative sentence, predicative function of *doen*, no modals, no coreferentiality or possession relations, no negation, mental caused event (lit. and fig.), 3rd Pers. Sg. Cr, non-volitional human Ce, 3rd Pers. Aff, EP *denken* + *aan*
4	indicative mood, declarative sentence, predicative function of *doen*, no coreferentiality or possession relations, no negation, mental caused event (lit. and fig.), Sg. Cr, human Ce
5	indicative mood, declarative sentence, predicative function of *doen*, main clause, no coreferentiality or possession relations, no negation, abstract 3rd Pers. Sg. Cr, non-volitional abstract 3rd Pers. Ce undergoing change, intransitive EP without PP complements
6	indicative mood, declarative sentence, predicative function of *doen*, main clause, no modals, no coreferentiality or possession relations, no negation, mental caused event (lit. and fig.), definite 3rd Pers. Sg. Cr, implicit human non-volitional Ce, 3rd Pers. definite Aff, EP *denken* + *aan*
7	indicative mood, declarative sentence, predicative function of *doen*, relative clause, no adverbial modifiers, no modals, no coreferentiality or possession relations, no negation, mental caused event construed as a physical one, material 3rd Pers. Sg. Cr, non-volitional material Ce undergoing change, EP *overlopen* without PP complements

Table 1. The most common features in each of the seven stable clusters. Abbreviations: EP – Effected Predicate, Cr – Causer, Ce – Causee, Aff – Affectee.

As the features in Table 1 suggest, all or most clusters share such features as the indicative mood, use in a declarative sentence, the predicative function of *doen*, the 3rd Person Causer, as well as lack of negation, adverbial modifiers, coreferentiality or possession relationships. These features do not look very informative. One can expect, for instance, most sentences in the corpora to be declarative, and most verbal constructions to be used in the predicative function. Coreferentiality and negation seem to be semantically and pragmatically marked phenomena. Of course, it is not excluded that some features may be highly informative about the semantics of *doen* (for example, previous research of the other Dutch periphrastic causative with *laten* by Levshina [2011] shows that the third person Causer and the lack of coreferentiality are less typical of *laten* than of *doen*), but a contrastive analysis of *doen* against other verbs is beyond the scope of the present study.

Let us now examine the seven clusters one by one. Cluster 1 with mental Effected Predicates and human Causees is related to affective causation, which usually involves mental effect of a stimulus on a cognizer. See example (5) from the cluster, very similar to (4) above:

(5)	*ja*	*dat*	*doet*	*mij*	*denken*	*aan*	*dat*	*boek*.
	yes	that	makes	me	think	to	that	book

"Yes, that reminds me of that book."

The stimulus (the Causer) is usually a singular object. The third-person Affectees, e.g. the book in (5), tend to indicate mental associations triggered by the stimulus (the Causer).

Cluster 1 is then subdivided into Clusters 3 and 4. Both of them inherit the mental Effected Predicates and human Causees from their parent. However, there are a few differences. Cluster 3 contains mainly the Effected Predicate *denken* with the preposition *aan*, as in (5), and non-volitional Causees, since mental associations like the ones discussed are uncontrollable (cf. Verhagen and Kemmer 1997). The broad and flat cluster looks very homogeneous, judging from the very small differences in the height of the amalgamations. Cluster 3 contains stable Cluster 6 with implicit Causees, as in (6):

(6)	*Het nummer*	*doet*	*met*	*zijn bombast*	*(...)*	*aan*	*zijn oude band*	*denken*.
	the number	does	with	its bombast		to	his old band	think

"The number with its bombast (...) reminds [one] of his old band."

The implicit backgrounded Causee indicates that the focus is shifted from the causation of the mental reaction to the intrinsic properties of the Causer (e.g. *zijn bombast* "its bombast"), which are often mentioned explicitly. Therefore, the highly frequent construction *doen denken aan* has idiosyncratic semantic and formal properties and particular functional extensions. These facts are perfectly in line with Bybee's observation of the correlation between frequency and autonomy of constructional subschemata (Bybee 2010).

Cluster 4 does not display any coherent distinctive properties, except for the fact that it contains Effected Predicates, which are different from *doen denken aan.* For instance:

(7)	*Scherpe*	*tweestemmigheid,*	*ook,*	*die*	*me*	*doet*	*verlangen*	*naar*
	sharp	two-voicedness,	too,	which	me	does	long	to

Gram Parsons....

Gram Parsons

"Sharp two-voicedness, too, which makes me crave Gram Parsons..."

In the left-hand Cluster 2 one can find non-human Causees and non-mental Effected Predicates, as in the following example:

(8)	*Een verhaal*	*in De Telegraaf*	*deed*	*het aandeel*	*met 18,3 procent*	*duikelen*.
	A story	in De Telegraaf	did	the share	with 18,3 procent	plummet

"A story in De Telegraaf caused the shares to plummet by 18.3%."

Cluster 2 contains two small clusters – 5 and 7. Cluster 5 contains abstract Causers and Causees. The latter undergo a change of state. This change of state is usually quantitative, e.g. plummeting of the shares in (8). Cluster 11 with only three observations is a very specific one. It contains the idiomatic metaphorical expression *de druppel die de emmer deed overlopen* "the straw that broke the camel's back" (lit. "the drop that caused the bucket to overflow")*,* as in (9):

(9) (…) *bij ons was't de druppel die de emmer deed overlopen*.

by us was-it the drop that the bucket did overflow

"With us, it was the straw that broke the camel's back."

After the discussion of the most stable clusters, it is necessary to clarify the status of the other ones. According to a rule of thumb in Hennig (2007), highly unreliable random clusters have an average Jaccard value below 0.50. There is only one such cluster (without any outline in Figure 2), which has the coefficient of 0.48. It amalgamates two observations, (10) and (11):

(10) *Ben nieuwsgierig of mijn info ergens een belletje doet rinkelen.*

am curious if my info anywhere a bell-DIM does ring

"I'm always curious if my info rings a bell anywhere."

(11) *Een handvol klassieke songs (...) zijn de uitsmijters die het publiek doen opveren.*

a handful classical songs are the bouncers that the public do leap

"A handful of classical songs (...) are the bouncers that make the audience leap to their feet."

The exemplars are indeed very different, although they both refer to some abstract stimulus that produces a mental reaction metaphorically construed as a physical event (10) or causally related to it (11).

The remaining clusters have a middle level of reliability. Some of the distinctions have been observed in the literature. For instance, non-affective Cluster 2 is split into two clusters. The cluster on the right has predominantly abstract Causers, as with the story in (8). The semantics of the cluster seems to be the closest to physical causation in Verhagen and Kemmer's (1997) terminology.

The cluster on the left contains concrete Causers (humans, organizations and one instance of a material object), as the football player Cziommer in (12). Many of the exemplars with human Causers express volitional causation, which happens as a result of the Causer's conscious efforts:

(12)	*Zo*	*deed*	*Cziommer*	*het*	*wel*	*voorkomen*	*voor*	*de camera's*.
	So	did	Cziommer	it	yes	appear	in front of	the cameras

“Cziommer made it appear so in front of the cameras.”

These clusters indicate some patterns in the data, but these patterns are not very stable. The other distinctions, which are captured by the more stable clusters, seem to be more salient in the use of the Netherlandic construction.

4.2. The Belgian network

The same analyses were carried out on the Belgian data. Figure 4 shows the cluster dendrogram with 66 Belgian exemplars. The numbers again stand for the clusters that are mentioned in the discussion.

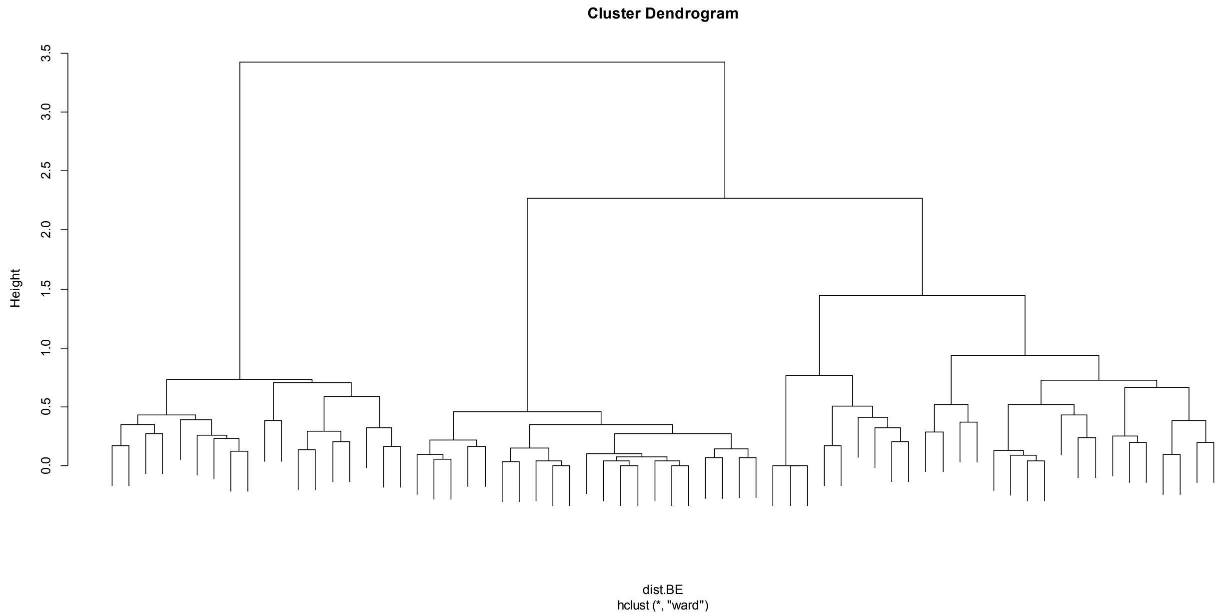

Figure 4. Hierarchical cluster analysis (Ward's algorithm) of *doen* in Belgian Dutch.

The first observation that can be made is that the structure is 'messier', that is, there are fewer flat homogeneous clusters than in the case of the Netherlandic *doen*. This observation is supported by a bootstrapping test (see Figure 5). The Belgian sample is less structured, since most of the observations are found in the clusters that are not very stable (gray and dotted outlines).

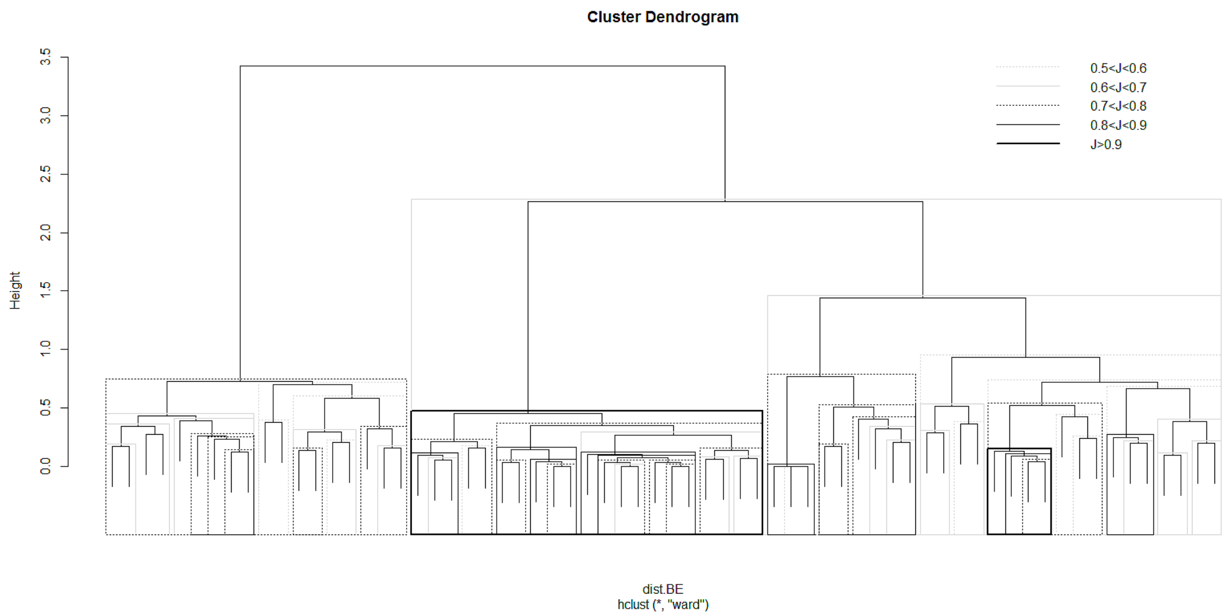

Figure 5. Hierarchical cluster dendrogram of the Belgian data with the stability values after the bootstrap with

replacement (n = 100). The outlines of the rectangles correspond to the Jaccard coefficient values (see the legend).

The most stable clusters (J ≥ 0.8) are shown in Figure 6. A bootstrapping run without replacement with 33 additional points showed that Clusters 2 and 6 were below the stability cut-off value. A similar bootstrapping run, but with 66 additional points, returned low stability values for Clusters 2, 6 and 3. This indicates that the cluster structure of the Belgian data is weaker than that of the Netherlandic taxonomy.

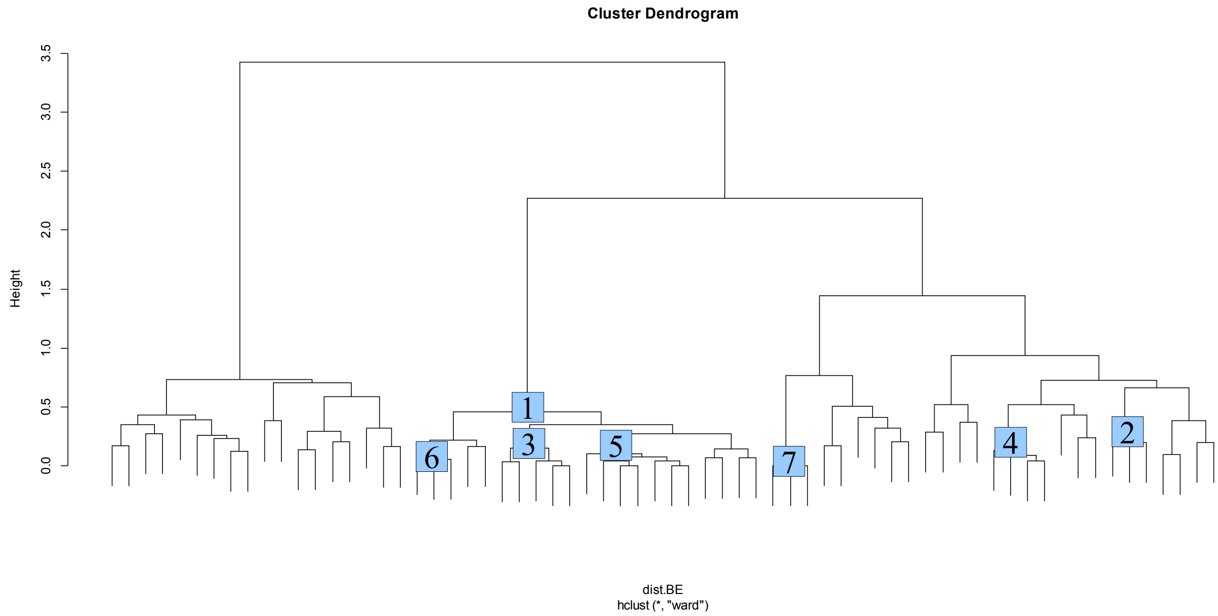

Figure 6. The most stable clusters (J ≥ 0.8) in the Belgian solution according to bootstrapping with replacement.

Are the stable clusters similar to the ones detected in the Netherlandic data? To interpret the solution, I examined the features shared by the members of the clusters. Since most clusters are very small, their description will be mostly qualitative. Cluster 1, which is highly stable, (J ≥ 0.9, thick solid black line), is lexically specific. It contains exclusively *doen denken aan*. Its subclusters differ mainly with regard to the semantic and formal expression of the main slots. Cluster 3 contains only abstract Causers with pronominal Affectees (*er* or *daar* “there”, often blended with the preposition *aan*), as in (13):

(13)	*dat*	*doet*	*mij*	*d'raan* *denken*	*dat*	*ik*	*nog twee disketten*	*heb*	*van*	*u.*
	that	does	me	that-to think	that	I	yet two diskettes	have	of	you

“That reminds me that I still have two diskettes of yours.”

The phrase (*dat*) *doet mij d'raan denken*, which is functionally similar to the English *by the way*, is frequently used to introduce a mental association in the form of a proposition, which may express something that the speaker does not want to forget. The meaning of the construction refers to the memory rather than the perception of similarity between things or situations.

Cluster 5 contains Affectees (the contents of the association) represented by nouns, as with the joke in (14):

(14)	*Dat*	*doet*	*mij*	*eventjes*	*denken*	*aan*	*een*	*anekdote.*
	that	does	me	a bit	think	to	a	joke

“That reminds me of a joke.”

Cluster 6 contains human Causers, who remind the speaker of someone else:

(15)	*Nù*	*pas*	*weet*	*ik*	*aan*	*wie*	*uncle*	*mij*	*doet*	*denken:*	*Hij*	*is*
	Now	only	know	I	to	who	uncle	me	does	think:	He	is
	David	*Brent!*										
	David Brent											

“It's only now that I know who uncle reminds me of: He is David Brent!”

Overall, it seems that the Belgian *doen denken aan* is less idiomatic than the Netherlandic one because it has a somewhat wider degree of applications. The original 'mental' meaning (*denken* means “think”) is quite salient in some cases, although the perception-related use is also common.

The other lexically specific clusters in the Belgian sample are Cluster 4 with *doen vermoeden* “make suspect”, as in (16), and Cluster 7 with *hoop doet leven* “while there is life, there is hope” (lit. “hope makes (one) live”).

(16)	*De komst*	*van*	*de nieuwe trainer*	*Rafael Benítez (...)*	*deed*	*geen*
	the arrival	of	the new coach	Rafael Benítez	did	no
	beterschap	*vermoeden.*				
	improvement	suspect				

“The arrival of the new coach Rafael Benítez (…) did not suggest any improvement.”

Cluster 2 contains three quasimetaphorical expressions that denote a change of mental state. One of them is (17):

(17)	*De*	*nederlagen*	*van*	*zowel*	*AC*	*als*	*Inter*	*doen*	*opnieuw*	*twijfels*
	the	defeats	of	both	AC	and	Inter	do	anew	doubts
	rijzen	*over*	*de*	*kwaliteit*	*van*	*het*	*Italiaanse*		*voetbal.*	
	rise	over	the	quality	of	the	Italian		football	

“The defeats of both AC and Inter again raise doubts about the quality of Italian football.”

As for the extremely low values, there is only one cluster with the stability value of less than 0.5, an amalgamation of two observations, which has the coefficient of 0.48. Interestingly, one of the observations, as in the case of the Netherlandic sample, is an instantiation of the construction *het belletje doen rinkelen*. This suggests that the collocation is a highly specific low-frequency construction, but it is not unique enough to form a separate cluster of its own.

To summarize, one can see that the Belgian solution has a weaker cluster structure. This conclusion was tested formally with the help of the so called agglomerative coefficient, which measures the amount of clustering structure found (Kaufman and Rousseeuw 1990). The Netherlandic solution had the agglomerative coefficient of 0.97, which was somewhat higher than the one for the Belgian variety (0.95). A disadvantage of this measurement is that it increases with the number of clusters, so that hierarchical clustering solutions tend to have very high values. That is why I also compared the agglomerative coefficients for several samples of various size, drawn from the same dataset without replacement. To ensure the stability of the results, 50 samples were drawn for each number of observations that was considered, and the average agglomerative coefficients were calculated. The results are shown in Figure 7.

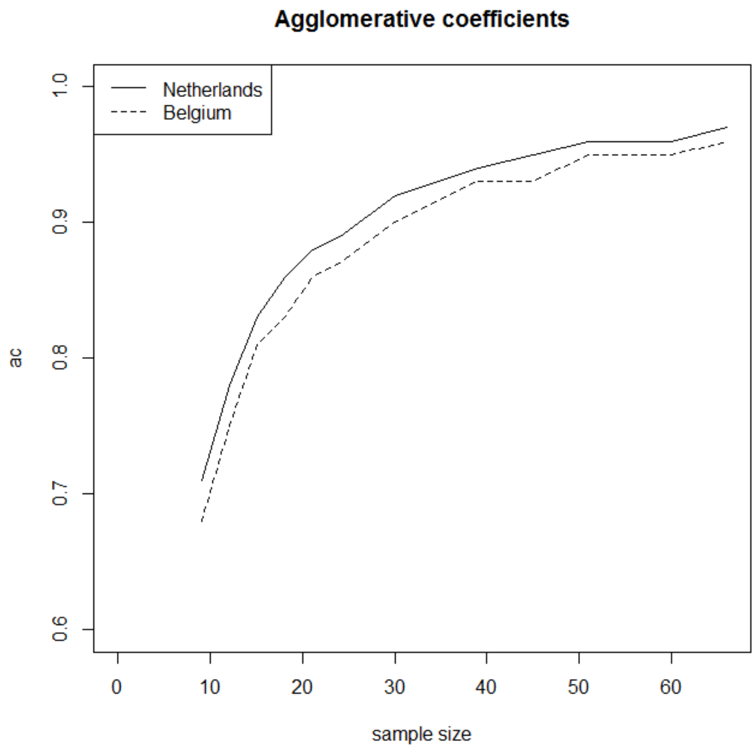

Figure 7. The region-specific average agglomerative coefficients for cluster solutions with different sample sizes. The number of iterations $n = 50$.

One can see that the Belgian data always display weaker cluster structure, regardless of the sample size. The difference is not great, but it is persistent. Of course, this approach does not say anything about the size of the clusters compared. As we have seen, the most striking difference between the Netherlandic and Belgian data is that the latter does not yield large clusters.

Further evidence of the differences in cluster structure comes from applying so-called partitioning around medoids with a pre-defined number of clusters. This method is similar to the popular *k*-means method, but it is considered more robust (Kaufman and Rousseeuw 1990). Figure 8 demonstrates the average silhouette widths for the solutions with the number of clusters from 2 to 20. The silhouette width is used in cluster analysis to represent the 'goodness' of a cluster. A good cluster is the one whose members are maximally similar to one another and maximally dissimilar to the members of the other clusters. The greater the silhouette width, the better the cluster. The average silhouette width of all clusters in a solution represents the goodness of the entire solution. Figure 8 demonstrates that the best cluster solution for the Netherlandic data is the one with only two clusters, and the goodness of clusters then decreases with some fluctuations. As for the Belgian data, it is difficult to say which number of clusters is optimal, which indicates a lack of cluster structure. This can be interpreted as the absence of significant large-scale generalizations in the network of the Belgian *doen*.

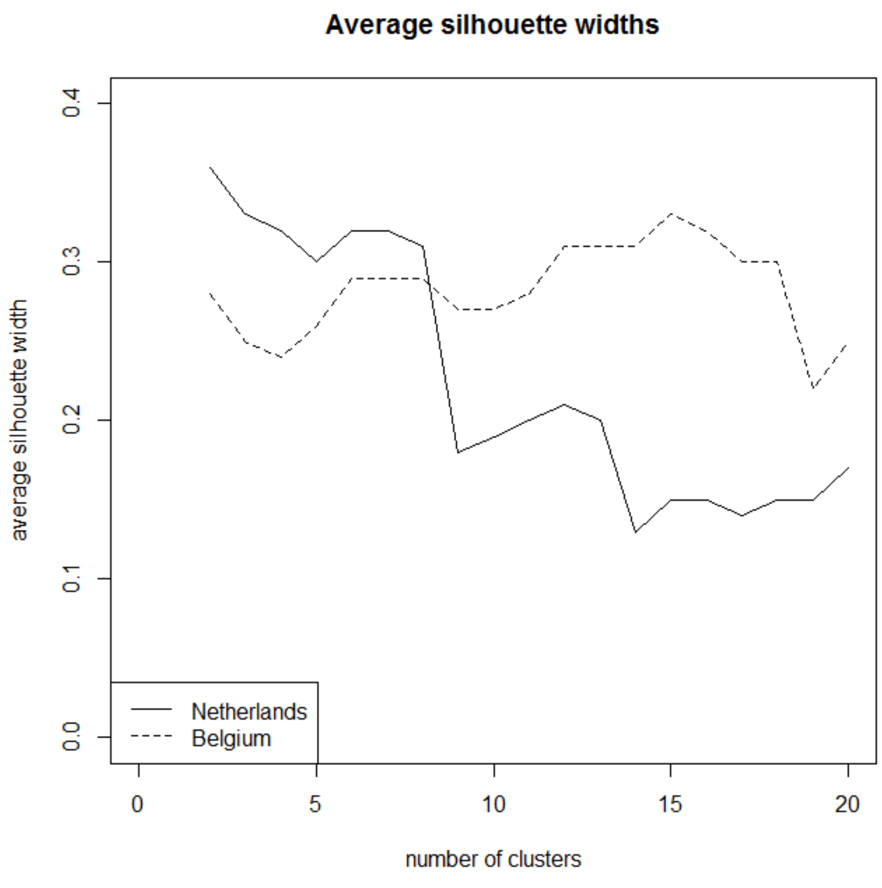

Figure 8. Average silhouette widths of clustering solutions based on partitioning around medoids.

5. Discussion

The analyses show commonalities and differences in the organization of the *doen*-constructicon in the two language varieties, or, taking a different perspective, in the polysemy of the causative auxiliary *doen* as a lexical category (cf. Dąbrowska 2009). One of the commonalities concerns the primary distinction between the observations in both varieties, i.e. the one between affective causation (usually with mental Effected Predicates, including *denken aan*) and other patterns. In addition, both varieties have a very distinct and highly stable cluster with the subschema *doen denken aan*, which forms stable subclusters of its own.

The most general difference between the varieties concerns the greater clarity of the cluster structure in the Netherlandic data, where all observations belong to several large stable clusters. In the Belgian sample, stable clusters are only found at the local level. The difference can be described in semantic terms: the Netherlandic causative *doen* is more polysemous than its Belgian counterpart, which exhibits more vagueness. Thus, we can formulate the hypothesis that the parent schema of the Netherlandic construction is weaker than that of the Belgian construction. This difference is represented schematically in Figure 9. The Netherlandic *doen* is organized in a way similar to Model A, whereas its Belgian counterpart exhibits more similarity to Model B.

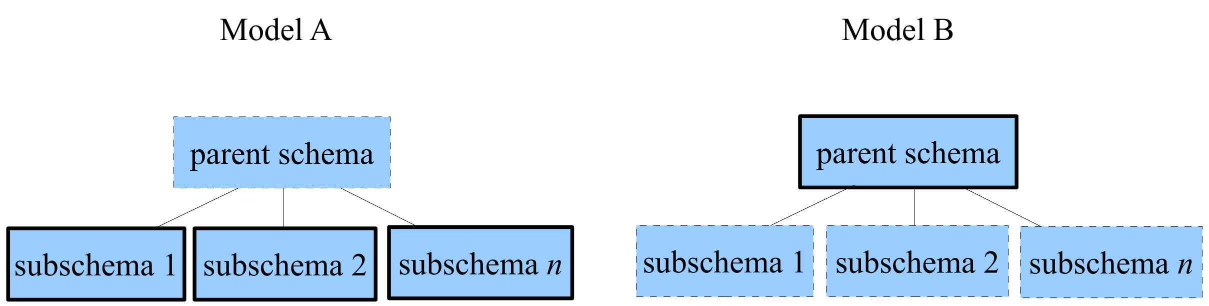

Figure 9. Two possible models of category organization. The outlines corresponds to the relative entrenchment of the schemata. Adapted from Croft and Cruse (2004, p. 309).

Although this hypothesis needs further empirical (especially psycholinguistic) corroboration, there are a few theoretical arguments that support it. First, Tuggy's theory of lexical ambiguity, polysemy and vagueness (e.g. Tuggy 2006) posits an inverse correlation between entrenchment and semantic distinctiveness of exemplars, on the one hand, and the entrenchment of the schema, on the other hand. Second, Bybee (2010, Ch.3) argues that the existence of autonomous frequent exemplars weakens the parent schema because the latter is not (fully) activated when the exemplars are accessed.

For empirical support of the claim, it is possible to operationalize productivity and entrenchment of a constructional schema as the type frequency of its exemplars (cf. Bybee 1985). Figure 10 shows the number of verb types (Effected Predicates) for different numbers of observations with *doen* in the corpus. According to the type frequencies of the Effected Predicates, the Belgian construction seems to be more productive, and therefore its abstract schema is more entrenched than that of the Netherlandic *doen*.

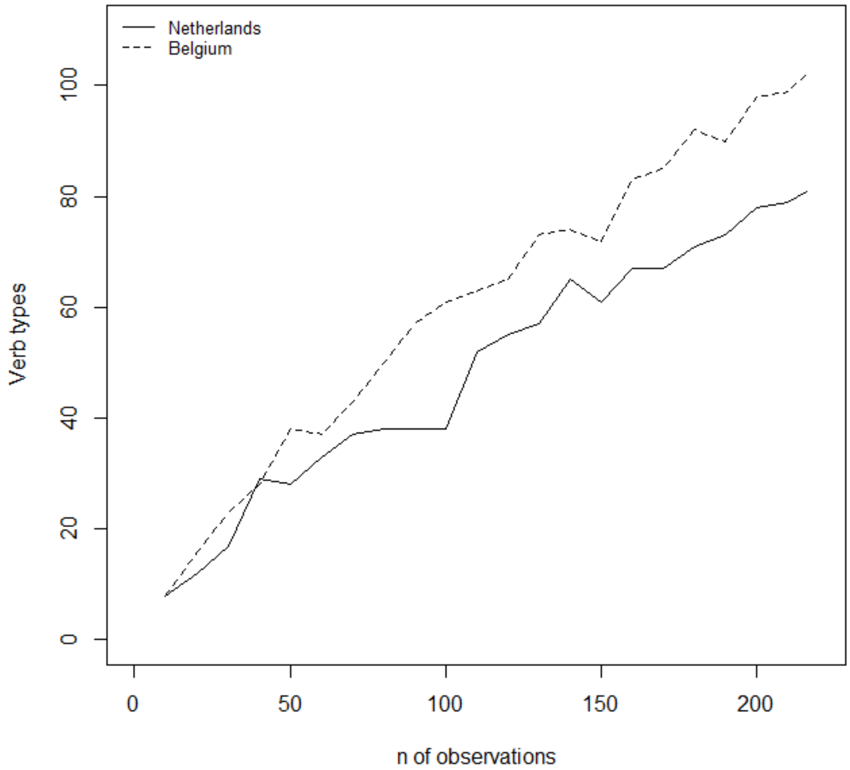

Figure 10. Verb type frequencies for different number of observations with the causative *doen*.

Further factual support of the hypothesis can be found in the diachronic research on *doen* (Duinhoven 1994; Verhagen 2000). The earlier variants of the construction used to exhibit greater semantic variation. More specifically, the inducive use of *doen*, which denotes interpersonal authoritative causation, was very common in the 18th century and for some time after (Verhagen 2000). Nowadays this use is perceived as archaic, although a few instances were found in the Belgian data, for instance:

(18)	*Ze*	*strooien*	*poeder op*	*je*	*vel*	*en*	*doen*	*je*	*slapen*	*op bevel.*
	they	spray	powder on	your	skin	and	do	you	sleep	on order

“They spray powder on your skin and make you go to sleep on command.”

The example is a line from a frequently quoted Flemish song from the 1960s about the repressive social order that controls the lives of the working class from infancy to death. The Causer *Ze* “they” represents kindergarten authorities. The Causees are little children. It is interesting that such uses are not found in the Netherlandic sample, but a few are present in the Belgian spoken and online data. Although there is controversy about the driving force of the semantic change – cultural or language-internal (Duinhoven 1994; Verhagen 2000), – we can safely conclude that the use of the causative *doen* has become more restricted. According to Speelman and Geeraerts (2009, p. 200), *doen* is “an obsolescent form with a tendency towards semantic and lexical specialization”. On the other hand, the Belgian variety is believed to have retained more archaic features than the Netherlandic one (Speelman and Geeraerts 2009). From the multivariate study in Levshina (2011) we know that *doen* is significantly more frequent in Belgian Dutch across different registers, and, as was mentioned in 2.2, Belgian speakers more often prefer it to its near-synonym *laten* than the Dutch do, other parameters being equal. The causative *doen* is also more frequent in written and more formal registers, which tend to be more archaic from the linguistic point of view, as well. The weaker parent schema of the more 'advanced' Netherlandic *doen* fits this general picture of the gradual decay of *doen* as a causative auxiliary.[7]

The network of *doen denken aan* in Netherlandic Dutch highlights the importance of pragmatic functions in the organization of the constructicon, such as the subjectivity vs. objectivity of the association, and backgrounding vs. foregrounding of the Causee. In the Belgian data, the clustering is to a large extent based on the semantic and formal properties of the main slots. All this supports the conclusion about the more autonomous status of *doen denken aan* in the Netherlandic variety, which has a number of idiosyncratic pragmatic extensions of its own. The greater semantic autonomy and frequency of *doen denken aan* in the Netherlandic variety is a vivid example of the

7 An additional factor involved may be a frequent use of the habitual and periphrastic *doen* in Netherlandic substandard varieties and in informal conversations (as our own analyses of the Spoken Dutch Corpus suggest). These uses are stigmatized, which may lead to a hypercorrect avoidance of *doen* as an auxiliary. This hypothesis is, however, left for future research.

correlation between these two parameters (Bybee 2010). The existence of the stronger autonomous exemplar is yet another fact in favour of the weaker schema of *doen* in Netherlandic Dutch.

The results also corroborate (or elaborate) some of the previous ideas about the network of *doen*. First, we have found indications of the causation types mentioned in the literature. Both the Netherlandic and Belgian samples have more or less homogeneous clusters, which correspond to affective causation. As for physical causation, the corresponding cluster was found only in the Netherlandic data, along with the volitional causation cluster, and both clusters had a middle level of stability. Note that the previous studies where the causation types were posited (Verhagen and Kemmer 1997; Stukker 2005) were based on corpora of Netherlandic Dutch only. The results thus clearly demonstrate the importance of geographically and socially representative corpora in constructionist research. As far as the other features are concerned, transitivity of the Effected Predicate does not seem to play a role, and implicitness of explicitness of the Causee is relevant only for *doen denken aan* in Netherlandic Dutch. However, note that these features were discussed only in the onomasiological intercategorial studies where *doen* was contrasted with *laten*. There is evidence that transitivity of the Effected Predicate and implicitness of the Causee play a very prominent role in the organization of the semantic structure of *laten* (Levshina 2011). These findings show that the semasiological intracategorial perspective is vital in constructionist research, because the networks of even closely related constructions can be organized very differently.

We have also observed some low- and medium-frequency lexically specific clusters in the two varieties: *de druppel die de emmer deed overlopen* “the straw that broke the camel's back” (lit. “the drop that caused the bucket to overflow”) was found in the Netherlandic variant, and *hoop doet leven* “hope makes (one) live” and *doen vermoeden* “suggest” (lit. “make suppose”) emerged in the Belgian sample. However, these differences may be due to chance. In a distinctive collexeme analysis in Levshina et al. (2011) based on a large topically-balanced newspaper corpus, the distinctive Netherlandic expressions were *doen denken aan*, *van zich doen spreken* “make one's mark” (lit. “make speak about oneself”), *doen voorkomen* “make appear, seem”, *doen besluiten* “make conclude”, *doen uitgaan* “send” and a few others. The expressions *het tij doen keren* “turn the tide”, *de vraag/twijfels doen rijzen* “raise the question/doubts”, *doen opmerken* “make notice” were among the distinctive Belgian expressions found in the newspapers. These expressions are quite different from the lexically specific clusters found in the present study, except for *doen denken aan*, which is more prominent in the Netherlandic variety, as well. Further fine-grained analysis is necessary to identify the region-specific low- and medium-frequency fixed expressions, which differ across genres and registers, as well as geographic and social communities, and are prone to topic bias, as Levshina et al. (2011) demonstrate.

6. Conclusions

In the previous sections, we discussed the possible hierarchical networks of the causative constructions with *doen* at different levels of abstractness in Netherlandic and Belgian Dutch. The networks were modelled with the help of hierarchical clustering analysis applied to a sample of corpus observations, which were coded for 35 semantic and formal features. Several clusters successfully passed a stability test based on the bootstrapping method. A few differences in the organization of the constructicon were detected. Most importantly, the Belgian construction has a weaker cluster structure, especially at the level of large clusters. Its semantics resembles vagueness, whereas the Netherlandic *doen*, which is organized in more autonomous large clusters, is more polysemous. This difference is at least partly due to the stronger position of the exemplar *doen denken aan* in the Netherlandic data. All this seems to suggest that the Belgian construction has a stronger schema than its Netherlandic counterpart. Although this hypothesis needs further empirical support, it fits the previous studies of the construction, which showed that *doen* is an obsolescent form, and it has stronger positions in the more archaic (Belgian) variety. Additional evidence based on the verb type frequencies as a measure of entrenchment and productivity corroborates this claim.

The results of the study allow for several broader theoretical and methodological conclusions. The main conclusion is that diachronically stable and socially/geographically uniform taxonomic trees and networks are probably more of an exception than a rule. In the usage-based model (Barlow and Kemmer 2000), differences in the input lead to different generalizations, the different generalizations provide different output, and so on. Similar to the Internet, the global constructicon of a language is a dynamic heterogeneous "network of networks". This is why the usage-based construction grammar should take into account this type of lectal variation.

From a broader theoretical perspective, this study can be seen as a contribution to the debate about the definition of constructions in different versions of usage-based construction grammar. According to the original definition in Goldberg (1995), the construction is stored in the constructicon only if it is not fully derivable from the other constructions. Langacker (2005) criticized this position for reductionism and suggested that all expressions with sufficient frequencies should be stored, regardless of their predictability and semantic transparency. More recently, Goldberg (2006) accepted this opinion. Recall that the highly frequent *doen denken aan* is also highly autonomous and has its own semantic and pragmatic extensions. Thus, high frequency leads to semantic idiosyncrasy and autonomy from constructional 'relatives'. This means that the above-mentioned definitions of constructions in practice converge.

The quantitative approach proposed here needs additional validation. It is necessary to obtain converging evidence from psycholinguistic experiments with Dutch-speaking subjects from the Netherlands and Belgium. Both the list of variables and their weights should be evaluated. However, the fact that the findings match the previous observations about the semantics of the construction and its development, suggests that the approach proposed here can be useful for models of constructional hierarchical networks and lexical semantic structures.

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