The ITB Journal

Volume 11 | Issue 1 | Article 3

2010

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Gottschalk, Judith (2010) "Storage of Linguistic Knowledge in the Mental Lexicon: an Approach Within Role and Reference Grammar," *The ITB Journal*: Vol. 11: Iss. 1, Article 3.
doi:10.21427/D76Q9Q
Available at: https://arrow.tudublin.ie/itbj/vol11/iss1/3

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Storage of linguistic knowledge in the mental lexicon: An approach within Role and Reference Grammar

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Abstract[1]

This paper aims to give an account of a theory of a mental lexicon for German verbs of motion within the theory of Role and Reference Grammar [RRG] (cf. Van Valin 2005). The issue of how Aktionsarten in general and particularly verbs of motion, with their various alternations, are structured and how they are stored in an RRG-compatible lexicon is investigated. A time line model for RRG-Aktionsarten based on Reichenbach (1947) is developed to give a description of the structure of events assumed within RRG. Human knowledge is often represented in terms of inheritance networks. In this paper I use a model of inheritance networks to modify the present version of the lexicon in RRG. I will argue that we do not need basic Aktionsarten in the lexicon, if we analyze and decompose Aktionsarten and operators in terms of inheritance networks. I will show furthermore that we do not need multiple lexical entries for verbs like motion verbs that occur in a multitude of contexts with different Aktionsart readings (see example 2.1.1.a, b and 2.1.4), if we accept the idea of inheritance networks. Neither do we need a workshop module and lexical rules as suggested by Van Valin and LaPolla (1997) and Van Valin (2005).

1. Introduction

The meaning of the term lexicon in linguistics is not comparable with a dictionary, where definitions of words are listed in alphabetical order. Instead, behind the term lexicon in linguistics there is a complex theoretical construction with multilayered word descriptions (cf. Jackendoff 2002). Chomsky added the term lexicon in Aspects (1965). Based on Bloomfield (1933), he explains that all unusual and unpredictable word-features must be included in the lexicon (cf. Jackendoff 2002: 153). Even if the way of looking at the lexicon has changed in modern linguistics, as many of the productive processes of grammar have been moved into the lexicon, one thing has not changed: the lexicon does not contain an indefinite repertoire of all potential sentences a speaker could say, but rather individual entries of certain words that are somehow stored (cf. Koenig 1999: 1). The issue of how such a lexicon is structured within the theory of RRG will be explored in this paper.

This discussion will proceed as follows. In section 2, the basic notion of Aktionsart and its formal representations within RRG are discussed. Furthermore, the empirical problem underlying this paper will be presented and the architecture of an RRG lexicon theory will be outlined. In section 3.1 I present the basic concept of inheritance networks and the present version of the RRG lexicon. In section 3.2. I develop a decomposition of the operators into features based on which an inheritance network can be construed. Section 4 sheds light on the the connection between the Aktionsart inheritance network and the operator inheritance network I have developed. In section 5 finally I sketch an analysis of German motion verbs and construe an inheritance

[1] I would like to thank Wilhelm Geuder, Volker Gottschalk, Kim Hülsewede, Anja Latrouite, Brian Nolan and Robert D. Van Valin, Jr. for comments on earlier drafts and many insightful discussions.

network for these verbs that will allow for simple lexical entries and dispense with the need for lexical rules to explain alternations.

2. Role and Reference Grammar

The theory of RRG is a functional grammatical theory that clearly differs from other theories in various ways. RRG is a monostratal syntactic theory, postulating one single syntactic representation for sentences. This is connected with the semantic representation of a sentence by linking rules. These rules will be summarized under the term *linking algorithm*. As RRG is a functional grammatical theory, discourse pragmatics also plays an important role. The basic theory of RRG can be found in Van Valin and LaPolla (1997) [VVLP] and Van Valin (2005) [VV].

The semantic representation of a sentence in RRG is based on the Aktionsart classification according to Vendler (1967), which divides sentences into states, achievements, accomplishments and activities. It makes use of a reworked and extended scheme of representation based on Dowty (1979) to describe differences among the Aktionsarten (cf. VV 2005: 31). However, there are several non-Vendlerian Aktionsarten in the RRG-framework. These are Semelfactives, Active accomplishments and all causative types of the Aktionsarten. Semelfactives were introduced in Smith (1997). They describe punctual occurrences which have no resulting condition (cf. VV 2005: 32). Examples are: *The light flashed, Max sneezed, The branch knocked against the window or Max spotted Claudius*. Between activities and Active accomplishments there is a derivational relationship. Active accomplishments describe the telic use of activities. While Vendler still describes sentences such as *Max has walked a mile* as being Accomplishments, Van Valin assigns the verb to the Active accomplishment in this morphosyntactic context, therefore presenting a derivational relationship to the activities. He draws a clear defining line between verbs which are telic and have dynamic elements, and thus are Active accomplishments, and verbs which are telic but not dynamic, and therefore are Accomplishments. However, there are verbs which are non-derived lexical active accomplishments. These typically are verbs which are telic and cannot alternate to Activites (cf. VV 2005). The causative types of the six RRG-Aktionsarten describe semantic differences in which a cause, for example a change in condition, can be identified. In the sentence *Max shattered the cup* the verb is a Causative Achievement. Van Valin characterizes the Aktionsarten with the help of four features:

(2.0.1)	State:	[+ static], [- dynamic], [- telic], [- punctual]
	Activity:	[- static], [+ dynamic], [- telic], [- punctual]
	Achievement:	[- static], [± dynamic], [+ telic], [+ punctual]
	Semelfactive:	[- static], [± dynamic], [- telic], [+ punctual]
	Process	[- static], [- dynamic], [- telic], [- punctual]
	Accomplishment:	[- static], [- dynamic], [+ telic], [- punctual]
	Active accomplishment:	[- static], [+ dynamic], [+ telic], [- punctual]

(cf VV 2005: 33)

RRG offers a number of syntactic and semantic tests which allow to determine the Aktionsarten of verbs. The lexical representation used in RRG, which was adapted by Dowty (1979), delivers an outline of the semantic processes described by the Aktionsarten. The verbs are analyzed via a decompositional lexical system, where

States and Activities form the basis. All other Aktionsarten are derived from them (cf. VV 2005: 42). In (2.0.2) an overview the logical structures [LSs] used in RRG is given:

(2.0.2)[2]	State	**predicate´** (x) or (x, y)
	Activity	**do´** (x, [**predicate´** (x) or (x, y)])
	Achievement	INGR **predicate´** (x) or (x, y) or INGR **do´** (x, [**predicate´** (x) or (x, y)])
	Semelfactive	SEML **predicate´** (x) or (x, y) or SEML **do´** (x, [**predicate´** (x) or (x, y)])
	Process	PROC **predicate´**(x) or (x, y)
	Accomplishment	PROC **predicate´** (x, (y)) & INGR **predicate´**((z), y)
	Active accomplishment	**do´**(x, [**predicate´**(x, (y))]) & INGR **predicate´**((z), y)
	Causative	α CAUSE β, where α, β, are LSs of any type Caus any type (cf. Van Valin 2005)

While accomplishment verbs like *melt* involve both a process taking place over time and an inherent endpoint of the process, which leads to a result state, achievement verbs like *pop* on the other hand do not have a process. They merely code a punctual event leading to a result state. It follows that an accomplishment can be analyzed as a process plus an achievement. This is true if the final moment of the process can be equated with the punctual event of an achievement. In some languages there are verbs coding processes directly without necessitating the implication of an endpoint or a result state. These verbs clearly differ from English verbs like *melt* and *dry*. The following examples are taken from Mparntwe Arrente (Wilkins 1989):

(2.0.3.)a.	Ayenge	irrente	ne-ke
	1sgNOM	cold	COP-PAST
	'I was cold.'		
b.	Ayenge	irrent-irre-ke.	
	1sgNOM	cold-PROC-PAST	
	'I got colder / cooler / *cold.'		
c.	Ayenge	irrente-arle-irre-ke.	
	1sgNOM	cold-RES-PROC-PAST	
	'I got cold.'		

The important contrast between (2.0.3b) and (2.0.3c) can be seen. The suffix *irr*e added to the stative stem *irrente* 'cold' means "become colder", but it does not mean "become cold". Accordingly, a change from less to more cold is coded, but it is not entailed that the process has reached its endpoint. In order to code the reaching of the endpoint, the suffix *arle* 'result' needs to be added. So in (2.0.3c) this suffix indicates that the process has reached its termination and yields a result state. The Mparntwe Arrente examples show that it is hence necessary to represent processes independently

[2] This representation of the LSs differs in various ways from the representations in VV(2005). Process is introduced as Aktionsart and the operator BECOME used in VV (2005) is erased as it decomposable into [PROC … INGR].

from a possible endpoint and result state. Therefore, the operator PROC for process is added. The decompositional representation is stated below:

(2.0.4)	a.	**cold´**(1sg)	*irrente*
	b.	PROC **cold´**(1sg)	*irrente + irre*
	c.	PROC **cold´**(1sg) & INGR **cold´**(1sg)	*irrente + arle + ire*

(Van Valin 2005: 44)

While INGR, SEML and [PROC ... INGR]can be used in connection with activity verbs, this is not possible with PROC. This is because PROC does not entail an event or transition, so it cannot be used to characterize some kind of pre-onset process. This however is possible with the other three operators.

2.1 One verb, many versions: the empirical problem

The empirical problem this paper deals with is described by Van Valin, Levin, Pinker etc. as follows: How is it possible that one single verb can occur in a multitude of morphosyntactic contexts (cf. VV in press). Here is an example:

(2.1.1)	a. The Cylons marched in Delphi.	atelic
	a'. The Cylons marched to Delphi.	telic
	b. President Roslin wrote	atelic
	b'. President Roslin wrote an e-mail.	telic
	c. Colonel Tigh ate.	atelic
	c'. Colonel Tigh ate a hamburger.	telic

If a motion-verb is being used atelically as an Activity, as in (2.1.2a), the locative PP is optional. If a Goal-PP is added, as in (2.1.2.), the same verb behaves like a telic verb and becomes an Active accomplishment. Here, the PP cannot be left out. The atelic creation-verb *write* behaves similarly to the motion verb *march*. Every time the object is specific or quantified it behaves telically, as in (2.1.2a). Thus an Activity-Active accomplishment alternation is presented. To the consumption-verb *eat* (2.1.2b) and (2.1.2c) the same pattern as to the creation-verb *write* applies. A further form of Alternation is the Causative-Alternation:

(2.1.2) a. The spacecraft blew up.
b. The missile blew up the spacecraft.

There are at least five possibilities of how the verbs in (2.1.2) are connected to each other. They could be listed separately as transitive or intransitive verbs in the lexicon. Or there could be a single entry in the lexicon for the verb, which underlies both forms and is specified for the transitive version of the verb. Pustejovsky (1995) holds this view. There could also be an alternating base-form which the transitive and intransitive form of the verb date back to. According to such a position, none of the verb-forms is a base form. This perspective goes back to Pinon (2001). The transitive form of the intransitives can also be derived from a causativation rule. Such phenomena occur in Huallaga Quechua (cf. VV 2005 : 41). On the contrary, the intransitive form can also be derived from the transitive. This would be analogous to Russian, French and Yagua. This connection can be read from the morphological form of the verbs (cf. VVLP 1997: 190, cf. Haspelmath 1993). I will not explain the various ideas of the construction of a mental lexicon as they have been constructed during the last decades of research in any detail within this paper however the alternations mentioned can deliver four ways of reading a single verb:

(2.1.4)	a. The Cylons marched in Caprica.	Activity
	b. The Cylons marched Starbuck across Caprica.	Causative Activity
	c. The Cylons marched to Starbuck`s spacecraft.	Active accomplishment
	d. The Clyons marched Starbuck to her spacecraft.	Causative Active accomplishment

The empirical problem may be summarized in the following questions: How many entries in the lexicon does a verb have if many of such morphosyntactic alternations occur? How can it be explained that a verb can be realised with different PPs? Are all representations connected through lexical rules, or are there underspecified lexical representations plus the information from NPs and PPs? The aim of this lexicon theory is to show how a lexicon can be constructed with the help of one single lexical entry for per verb with the help of multilayered inheritance hierarchies.

2.2 Architecture of an RRG-compatible mental lexicon

Semantic hierarchies in which lexical information is inherited from one node to the other, are called inheritance networks. In processing-systems for natural languages, inheritance networks have been inserted as models of linguistic knowledge since the 1960s. This allows human knowledge to be coded in a flexible and efficient way. They also allowed to make inferences about the objects in a domain. A number of linguistic theories extensively use inheritance networks: construction grammar, Head-Driven-Phrase-Structure-Grammar [HPSG] as well as cognitive grammar (cf. Koenig 1999: 3).

As the lexicon is a part of human knowledge, therefore it can be expected that – like everything in human knowledge – even this is hierarchically structured (cf. Koenig 1999: 14). In an inheritance network, properties are assigned to a node. In this process, attributes are functionally represented as values. Qualities of node A can be inherited by node B if B is a successor of A. There are different types of inheritance. In simple inheritance, every node except for the root has exactly one predecessor. In multiple inheritances at least one node has more than one predecessor. In monotone inheritance every successor B has all of the qualities of A. The same values as A are assigned to all of the attributes of B. Non-monotonic inheritance functions just like monotonic inheritance via default. However, a successor of B may have other qualities than A. In this case, the attribute f will be assigned with a different value than A, or an attribute will be added that A does not have. In my account of an RRG lexicon I will make use of non-monotonic inheritance networks.

As a possible solution to the empirical problem described on the previous pages, the following working hypothesis will be explored: An inheritance network and lexical rules can be used to establish an RRG – lexicon theory. This working hypothesis entails a few basic assumptions: I assume that lexical knowledge is hierarchically structured by verbs in terms of *lexical fingerprints*. A fingerprint normally describes a non-redundant, underspecified functional assignment of values and attributes which are directly connected to the concepts of world ontologies and which determine the semantics of the verb. Constructing the fingerprints, it is necessary to find out the required reference points, but it should also be possible to define them with as much as less redundant information. So a fingerprint specifies the node's qualities in an inheritance network and describes inheritance in the inheritance network. Another assumption is that verbs are contained in a specific lexical domain, following the example set by Marial and Faber (2005). I call these domains *district clusters*. District clusters spread out into semantic *neighborhood clusters,* which specify district clusters of verbs in more detail in their meaning. Verbs of the lexical domain MOVEMENT are diverse. They can be used to describe several kinds of motions from one place to another. It is possible to go by car, by train, by ship etc; it is also possible to move without technical aid on foot, to walk, to run or to go rambling. Furthermore, it is possible to crawl, to swim or to climb a mountain. All these verbs describe a movement from destination A to B and nevertheless they differ significantly. Therefore, they belong to different neighborhood clusters in one district cluster. In addition to the district cluster of motion verbs, plenty of other district clusters like emotion verbs, cognition verbs etc. exist (cf. Mairal and Faber 2005: 5).

One can look at the lexicon as being a pure warehouse of lexical knowledge, full of words and morphemes. Lexical rules are a phenomenon that, according to Van Valin, does not occur in the lexicon, but rather in a different module he calls *workshop*. The semantic representations are constructed from material stored within the lexicon (cf. VV 2005: 161). Actually, the lexicon is divided into two parts: the traditional lexicon, where morphemes and words are stored as in a storehouse and the workshop where, by using lexical rules and other lexical processes, new lexical forms are created which are not stored otherwise (cf. VV 205: 161). As I said in the introduction, modern linguistics postulates that many productive processes of grammar take place within the lexicon. One reason for this is the development of rules which form part of the processes within the lexicon. Based on these rules, it was possible to add important generalizations. These are called *lexical redundancy rules [LRRs]*. They are accepted in most generative theories. The adding of LRRs goes back to Chomsky (1970) and was extended in Jackendoff (1975). The question connected to so-called lexical rules (LRs) reads as follows: Are verb alternations best described as separate lexical entries, or can they be described with the help of LRs (cf. VVLP 1997: 178)? Van Valin and LaPolla propose the following LRs:

(2.2.2)

Activity [motion] → active accomplishment: given an activity LS **do´** (x, [**pred´** (x)]), add '& INGR **be-LOC´** (x, y)' to form an active accomplishment LS.

Activity [consumption] → active accomplishment: given an activity LS **do´** (x, [**pred´** (x, y)]), add '& INGR **consumed´** (y)' to form an active accomplishment LS.

Activity [creation] → active accomplishment: given an activity LS **do´** (x, [**pred´** (x, y)]), add '& INGR **exist´** (y,)' to form an active accomplishment LS.

(cf. VVLP 1997: 180)

In accordance with Van Valin and LaPollas' analysis regarding the structure of a mental lexicon, and with regard to Van Valins' notation of the workshop (cf. VV 2005: 161), the following illustration of the storage of linguistic knowledge in the mental RRG lexicon has been drawn:

1. Verbs that alternate only have one single lexicon entry, unless they are polysemous –
2. Verb Alternations can be described with the help of derivational lexical rules (cf.

VVLP 1997: 178ff). 3. The use of lexical rules is not a process that occurs in the lexicon; rather it happens in the workshop (cf. VV 2005: 161).

3. Time-line model for the RRG operator and the state of affairs network of supplies

Using Reichenbach's (1947) and Löbner's (1988) analysis, it is possible to claim all of the Aktionsarten to be arranged on one time-line. I hereby assume the ontology of the operators to be universally valid for all languages. This corresponds to the suppositions about operators in Dowty (1979), Foley and Van Valin (1984), VVLP (1997) and VV (2005). These time-lines are universally valid for all languages, since they illustrate physical progress in time independent of linguistic aspects. In this case one can assume universal validity. Here is a presentation of the lexical Operators **do´**, PROC, INGR and SEML as time-lines:

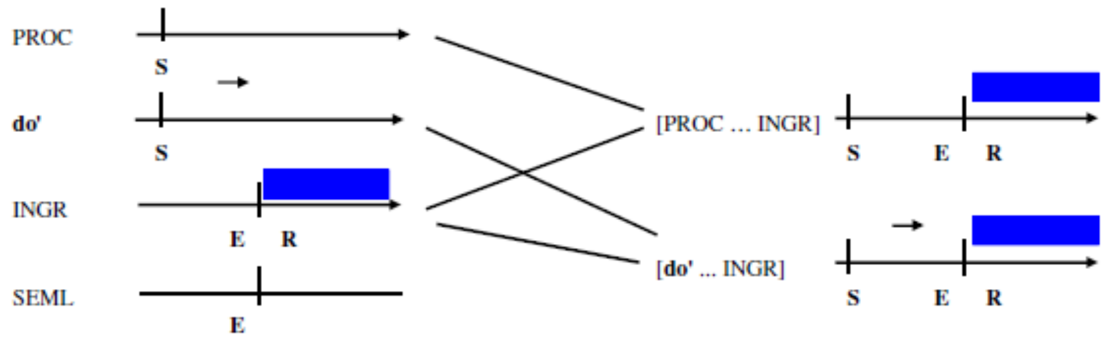

Figure 3.0.1: the lexical Operators **do´**, PROC, INGR and SEML as time-lines

With regards to notation, S marks the starting point or the beginning of a state of affairs [SOA]. An SOA shows a starting point or beginning if a process lies on the time-line. E stands for event and describes an occurrence on the time-line within the SOA. R describes the result of an event. This is additionally shown by a colored mark on the time-line. In principle the time-line is unlimited. Because of this, it cannot be terminated, which will be pointed out by an arrowhead.

In this model, a special position is assumed by the timeline for the operator SEML. In analogy to the other events with PROC, **do´** and INGR, SEML also describes an event on the time-line. However, this event does not result in a Result State. On the time-line, this is made clear by the lack of a colored marking for the result state. In addition, the time-line belonging to SEML does not have an arrowhead.

Besides, it becomes clear in figure 3.0.1. that the time-lines coded by operators [PROC ... INGR]and [**do´**… INGR] are both derived operators. [**do´**… INGR] is derived from the operators **do´** and INGR. BECOME is the operator used in the LS of Accomplishments. The operator hybrid [**do´** … INGR] is used in the presentation of Active accomplishments. For '[PROC ... INGR]', INGR and SEML the following relational correlations are valid - S ≠ E indicates that the starting condition of the SOA is not equal to the event E. This applies to the '[PROC ... INGR]'-Operator and to the hybrid [**do´** … INGR]. For the operator INGR, S = E is valid. Consequently, the event E is identical to the starting point S, in correspondence to the general definition of an ingressive. According to Löbner, an ingressive event occurs if a transition to a completely new condition takes place. (cf. Löbner 1988: 185). The relation shown here reveals the moment when the ingressive takes its start. In doing so, the punctual components of the INGR-Operator are captured. However, as these relations should merely describe the relationship between starting condition and event, the relation S = E is also valid for the SEML-Operator.

In the following I will demonstrate that the time-line presentation of operators can also be presented as an inheritance network. Within this inheritance network, the operators are defined on basis of the nodes of the network's individual paths. Thereby, their semantics is determined.

To this end, binary features, which can be derived from the time-lines in figure 3.0.1, are readily available. The features are [± event], [± punctual]. [± dynamic] and [± result state]. They resemble the features of the Aktionsarten which Van Valin has presented (cf. VV 2005: 33). The root-node of the SOA-network is the abstract node SOA. The Aktionsart State cannot be represented by a separate operator in the logical structures of RRG. It is also permissible to view State as being an abstract node within the SOA-network, comparable to the root-nodes of SOA. The distinct feature of the Aktionsart State is that it does not describe an occurrence that could be described on a time-line. For this reason, States occur from the feature [- event] inside of the SOA-network. Vendler suggests a division of verbs into the groups State and Non-State (cf. Vendler 1967: 99).

In any case one fact is certain: apart from States, all other Aktionsarten are described by the feature [+ event]. From this it can be inferred that the nodes [+ event] and [- event] make up the first distinctive sister-node-pair. The [± punctual]-differentiation must of necessity follow the [± event]-node in the SOA-inheritance network. This is revealed in the time-lines-perspective of the definition of RRG-Operators already described above. If the feature [- punctual] is shown, the operator which is to be defined does not describe a punctual occurrence. Rather, it describes a somehow disposed process. Therefore, only operators like **do´**, PROC, [PROC ... INGR] and [**do´** ... INGR] can follow the tree-path to [-punctual]. These refer to Activity, Accomplishment and Active accomplishment. If the operator which is to be defined is followed by the node [+ punctual], then the relational correlation to the time-line is S = E.

This relationship is valid for the operator INGR as well as the operator SEML. Below the sister-nodes [+ punctual] and [- punctual] is a secondary pair of nodes, [+ dynamic] and [- dynamic]. Activities and active accomplishments involve such an action. Therefore, these verbs can be modified by adverbs such as *violently, vigorously, actively, strongly* and *energetically.* On the other hand, states, achievements and also accomplishments do not code dynamic action. This is why these verbs cannot co-occur with the adverbs mentioned. There are semelfactives which can co-occur with those adverbs, *e.g.* the sentence *Commander Adama coughed once violently* is grammatical, while other verbs cannot be used this way, *e.g.* **Colonel Tigh glimpsed the Cylon strongly* (cf. VV 2005: 33).

The final group of distinctive sister-nodes that forms a binary division of the RRG-operators, allowing for their definitive identification, is [+ result] and [- result]. This feature can be approximately equated to the feature [± telic] in the SOA-inheritance network which is used in RRG. The operators' **do´** and PROC have no inherent point of termination. There is a starting point S, but there is no point E on the time-line that terminates in a Result R. This is why **do´** and PROC can be found under the node [-result] in the SOA-Network. The operator SEML contains the feature [- result].

Semelfactives are pure occurrences without any change of condition. In the sentence *The LED-lamp flashed once* the LED-lamp has the same condition before and after the occurrence of flashing. The operators presented at the end of a tree-path which contains the feature [+ result state] are INGR, [**do´** … INGR] and [PROC ... INGR]. Here it becomes clear that INGR is a kind of transitive function, which describes a change in condition.

The tree-paths which lead to these operators are analogous to the time-lines of [PROC ... INGR], INGR and [**do´**...INGR] already described above. Both time-lines show a point E, which transfers the starting condition S to the finishing-condition R. At this point it is insignificant if the relation $S \neq E$ or $S = E$ is concerned in this case. The feature [+ result] describes the telic quality of a verb. Active accomplishments are therefore telic. This is why they terminate when their goal has been reached, and move on to a condition where the occurrence has been accomplished and has occurred on the time-line in its changed condition. The sentence *Max has eaten up the schnitzel* is telic because here the eating-occurrence of the schnitzel has terminated with the consumption. It is henceforth valid that Max has eaten the schnitzel. The situation is similar with *Claudius drove to the Paul-Janes-Stadium*. Here, the result has been achieved as soon as Claudius has reached Paul-Janes-Stadium since his journey to the stadium is terminated and as a result he can watch the football game. Achievements also have a Result. If a house blows up or a cup breaks, the Result follows the moment when the house blows up or the cup is broken. An Achievement describes a change from a condition, for example the not yet blown up house or the whole cup, to a new condition, namely the blown up house and the broken cup.

On the time-lines this is presented in figure 3.01. As a change is described, the operators describing these verbs, which are used in the LS of RRG, are represented in the SOA-Network by the feature [+ result]. For a sentence like *The ice in the motorway ramp melted,* this condition was the result of a melting process going on for some time (cf. VV 2005: 34). The feature [± telic] was not used here, because it points to the termination point of the verb more strongly, while [+ result] points towards the complete time-line after the Event E on the time ray. Therefore, the feature [± result] is a more adequate binary representation of the SOA described on the time-line of the operators than the feature [± telic], even though they only marginally differ in their power of description.

The network developed here looks like this:

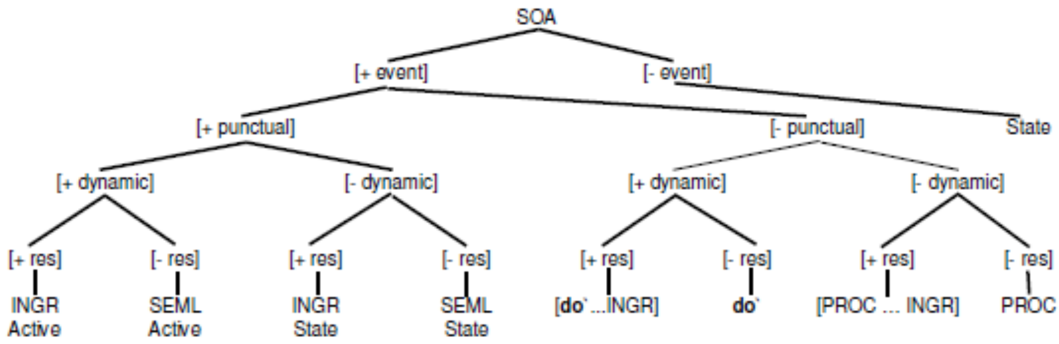

Figure 3.0.2: ***The SOA-Network***

Within the SOA-Network, the SEML-Operator surfaces on two paths – Both the path [+ event], [+ punctual], [- dynamic], [- result state], as well as the path [+ event], [+ punctual], [+ dynamic], [-result state] end in a SEML-Operator. The Operator INGR also occurs twice in the SOA-Network. Just like SEML, this operator can be derived from a State and also from an Activity. It can code a dynamic event, but at the same time it may also code a non-dynamic event. Therefore, it appears twice within the SOA-network. At one time, INRG inherits is properties from [- dynamic] and codes an INRG state and at the other it inherits its properties from [+dynamic] and codes an INGR activity.

4.0 The inheritance network of RRG-Aktionsarten

Van Valin gives clear implications as to what an inheritance network of RRG Aktionsarten looks like. He argues that State and Activity predicates are the basic Aktionsarten all other Aktionsarten can be derived from (cf. VV 2005: 42). On basis of the logical structures, which have already been described, and which are based on lexical decomposition, a hierarchical pattern among the Aktionsarten and their inheritance relationships can clearly be recognized (cf. VV 2005: 42). Based on table 2.0.2, State and Activity form basic Aktionsarten from which almost all other Aktionsarten can be derived.

Achievements, which describe a punctual change, for instance, can be represented either by a State LS or an Activity LS plus the INGR Operator. Semelfactives can also be represented either by a State LS or by an Activity LS plus SEML-Operator. Processes can be derived from States only. They cannot inherit their properties from Activities, as Processes do not code dynamic events. This is also shown in the SOA-Network. Active accomplishments are composed of an Activity LS and an Achievement LS.

The LS for the Activity component is linked with the LS of an Achievement, by a conjunction in Active accomplishments. The Achievement LS either describes a change in location or the result of a change in condition, arrived at by consumption on one side and by creation on the other. Examples of such representations are given in example (4.0.1):

(4.0.1) a. **do´** (Cylons, [**march´** (Cylons)]) & INGR **be-at´** (Pilgrim Bay, Cylons)
a’. The Cylons marched to Pilgrim Bay.

b. **do´** (Starbuck, [**eat´** (Starbuck, Jelly Beans) & INGR **consumed´** (Jelly Beans)
b'. Starbuck ate the Jelly Beans.
c. **do´** (the Chief, [**build´** (the Chief, spacecraft)]) & INGR **exist´** (spacecraft)
c. The Chief built a spacecraft

(cf. VV 2005: 44)

It becomes clear that if Active accomplishments are presented within an inheritance network of Aktionsarten, they have the qualities of both Activities and of the static Achievement derivation, so afterwards they are a hybrid of these Aktionsarten. In the SOA-Network this is shown for the combination of operators [**do´** … INGR], which defines Active accomplishments. As mentioned before, Accomplishments code an event which is decomposable as '[PROC ... INGR]'. So Accomplishments inherit from Processes on the one hand and static Achievements on the other. This kind of inheritance can be explained by the fact that they do not code any dynamic event. The causative forms of RRG Aktionsarten also have a special position.

The structure of causative verbs is complex. In this case an activity predicate is usually used and linked to a predicate which indicates the resulting state of affairs. Here the operator-connective CAUSE is used, e.g. [**do´**...] CAUSE [BECOME **pred´**...] (cf. VV 2005: 42). Fundamentally, every RRG-Aktionsart has a causative form. Effectively there is an inheritance network of causative forms. An inheritance relationship between every single Aktionsart and its causative form is retained. To simplify the presentation this second diverted inheritance network is presented in form of a single node CAUSE, which inherits the basic inheritance-network from every node. Based on this information, the inheritance network described in figure 4.0.1 can be constructed:

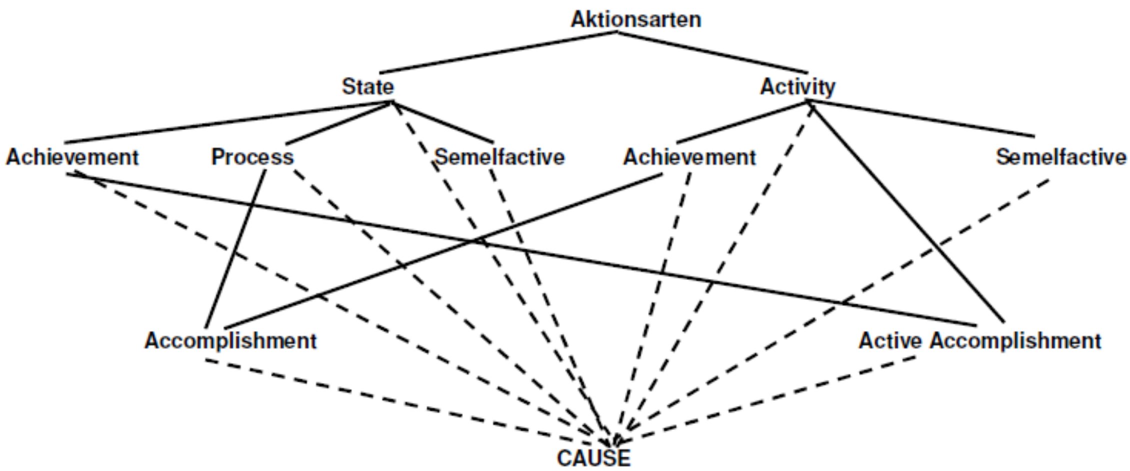

Figure 4.0.1: The inheritance network of Aktionsarten

It is crucial to be aware that the Aktionsart network is developed on an abstract level here. It describes all theoretical possibilities of inheritance relationships between the Aktionsarten. This is not to say that a language must have all of the Aktionsarten. An obvious example is Causatives. Mandarin for example has no lexical causative verbs. This does not mean no causal connections can be described in Mandarin. Rather, in Mandarin causatives are not lexicalised as single verbs, instead they are expressed by serial verb constructions (VV p.c.).

4.1 Connection of the SOA-network and the Aktionsart network

The inheritance relationship between the operators INGR, SEML, [**do´**... INGR], **do´**, [PROC ... INGR] and PROC and their semantic regulation is something completely different from the inheritance relationship between the Aktionsarten. The semantics of the operators is clearly determined in the SOA-Network. The LSs that are described in the Aktionsart network now inherit all of the qualities of the current operators in a monotone manner. In figure 4.2.1 the complete inheritance network of RRG Aktionsarten plus the SOA-Network is illustrated:

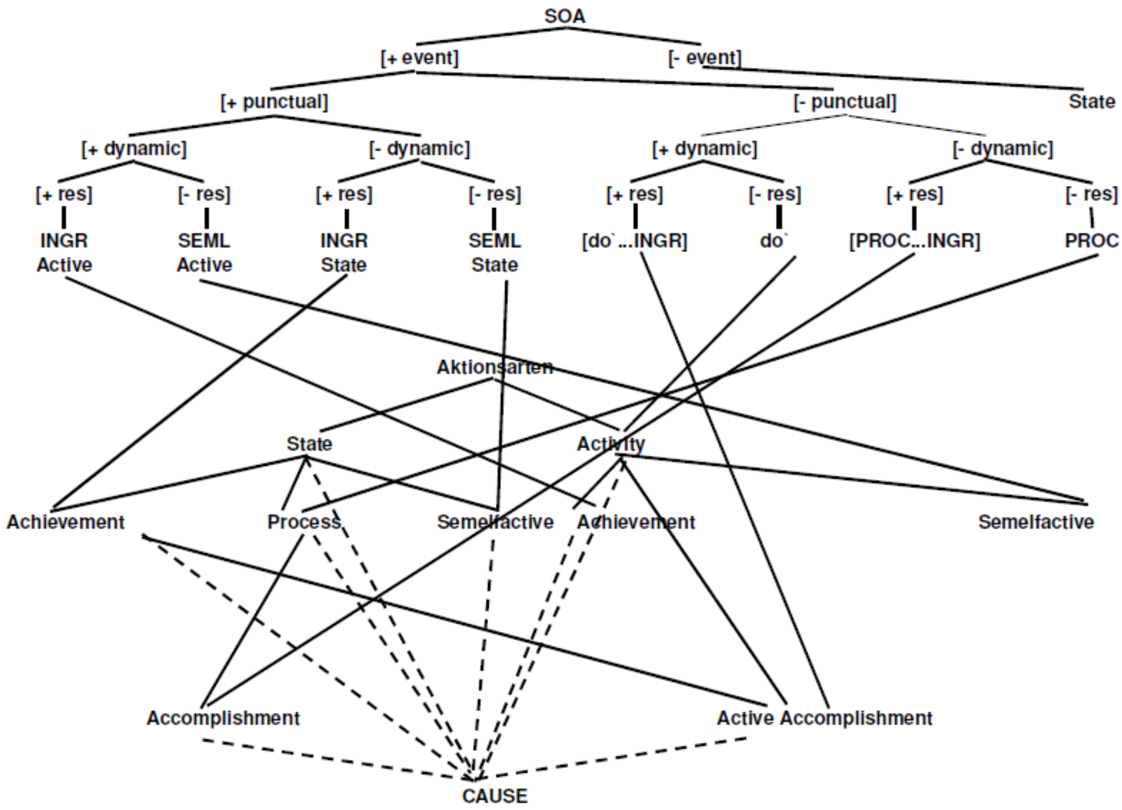

Figure 4.1.2: The SOA-network connected with the Aktionsart network

Figure 4.1.2 consists of the SOA-Network and the Aktionsart network with the CAUSE-dimension added. One can also regard this network as part of the semantic inventory of a language. The Aktionsarten completely inherit the semantic definition from the operators in the SOA-Network. The basic Aktionsarten Activity and State inherit one of the **do´**-Operator (Activity) and also from the abstract State-nodes (state). This node may not be equated with an operator. It is an abstract node which has the distinctive quality [- event].

In the Aktionsart network, States inherit from this node. As a result, State is semantically determined as being an Aktionsart which does not describe any occurrences on a time-line. Semelfactives which are derived from Activities in the Aktionsart Network inherit from the SEML-Operator in the SOA-Network, which defines the feature-bundle [+ event], [+ punctual], [+ dynamic], [- result]. Semelfactives which are build on States inherit from the SEML-Operator, which is semantically determined by the feature-bundle [+ event], [+ punctual], [- dynamic], [- result]. Achievements show a similar inheritance scheme. In their Activity-derivation, they inherit from the INGR Operator which has the feature-bundle [+ event], [+

punctual], [+ dynamic], [+ result]. In their State-derivation however, they inherit from the INGR-Operator in the SOA-Network which has the feature-bundle [+ event], [+ punctual], [- dynamic], [+ result]. Processes inherit properties from the PROC-node in the SOA-networks. As Accomplishments code events consisting of '[PROC ... INGR]', they inherit from both the static INGR-node and the PROC node.

There already is a semantic difference between the Activity and the State diversion of Semelfactives or also the SEML-Operator within the SOA-Network. This also holds true for Achievements or as the case may be the INGR-Operator. This can be explained simply by the structure of the SOA-Network, which is built up of the binary differentiation of [± event], [± punctual], [± dynamic] and [± result]. On basis of this binary characteristic it is already possible to classify the SEML and INGR-Operators into different diversions in the SOA-Network .

5. Analysis of a domain of German verbs

I will analyze the Aktionsarten of a domain of German motion verbs in this section. The verbs I will examine are *gehen* 'go', *spazieren* 'walk', *rennen* 'race', *sprinten* 'sprint', *schlendern* 'amble', *trotten* – 'jog', *laufen* 'run', *marschieren* 'march', *wandern* 'hike' and *wate* 'wade'.

With respect to these verbs there is one kind of alternation possible in German. The activity-active accomplishment alternation. Example (5.0.1) shows this alternation in German:

(5.0.1)	a. Mulder	wander-t.		
	Activity			
	Mulder	hike-3sgPRES		
	'Mulder is hiking.'			
	a'. Mulder	wander-t	zur	Area 51.
	Active accomplishment			
	Mulder	hike-3sgPRES	to	area 51.
	'Mulder is hinking to the area 51.'			
	b. Scully	spazier-t.		
	Activity			
	Scully	walk-3sgPRES		
	'Scully is walking.'			
	b'. Scully	spazier-t	nach	Black Mesa.
	Active accomplishment			
	Scully	walk-3sgPRES	to	Black Mesa.
	'Scully is walking to Black Mesa.'			

Van Valin and LaPolla state that alternating verbs, which are shown in (5.0.1), have alternated from an activity to an active accomplishment by adding a goal-PP. This means that these verbs have a basic Aktionsart, in this case activity. This alternation is possible with all the verbs under investigation. Van Valin and LaPolla explain these verb alternations by the use of lexical rules which apply in the workshop (cf. VV 2005: 47). Based on the networks which were constructed in section 4, another explanation for verb alternations is possible. In this analysis, no basic Aktionsarten are needed and no lexical rules apply.

Based on the results of section 4, another perspective on the realization of an RRG-lexicon is possible. For this reason I will have to correct my working hypothesis. It is thus possible to add inference rules to the inheritance hierarchies within the lexicon instead of using lexical rules. Here, the forms which are stored in the lexicon are connected directly in inheritance hierarchies. The indirect way via the workshop does not apply.

The architecture of this RRG-lexicon is geared to DATR, a programming language invented by Evans and Gazdar in the late eighties, used for the representation of lexical knowledge of various domains (mostly applied in morphology and phonology) (cf. Evans and Gazdar 1996). These inheritance hierarchies and inference rules apply within the lexicon. They connect individual elements in the networks as well as the various networks to each other. This is very similar to inference rules in DATR, which can be monotonic on the one hand and non-monotonic on the other. If such inheritance hierarchies and inference rules are used, it is not necessary to assume that a verb has a basic Aktionsart, due to the fact that each verb is directly connected with its alternating forms on the basis of inference hierarchies and inference rules.

Now it is possible to develop a *general logical structure [GLS]* for the domain of motion verbs under investigation. Following Van Valin and LaPolla it is possible to unite all verbs of a specific lexical domain in a single general logical structure. The differences among these verbs will fall out from the way the variables in the representation are interpreted (cf. VVLP 1997: 117). I adapt the model of GLSs developed by Van Valin and LaPolla (cf. VVLP 1997: 116-8). In constructing a GLS for motion verbs in German it is first necessary to analyze which arguments the motion verbs appear with as a rule.

This serves to determine which internal variables have to be realized in the GLS. It is necessary to know that the quantity of the internal variables depends on the concrete decomposition of the analyzed verb domain and that it is not determined (cf. Van Valin and Wilkins 1993, cf. Mairal und Faber 2002). For this development it is necessary to determine first which morphosyntacitc contexts the verbs can occur in.

I carry out this examination on basis of the motion verb *fliegen - to fly*. This verb does not belong to the specific verb domain in German which I examine in the context of this case study, but I will show that *fliegen* ‘fly’ provides some interesting implications for the construction of a GLS for motion verbs:

(5.0.4) a. Mulder segel-t.
Mulder sail-3sgPRES
'Mulder is sailing.'

b.	Mulder	segel-t	mit	der	Jolle.	
	Mulder	sail-3sgPRES	with	the.MsgDAT	jolly-boat.	
	'Mulder is sailing with the jolly-boat.'					
c.	Mulder	segel-t	in	der	Jolle.	
	Mulder	sail-3sgPRES	in	the.MsgDAT	jolly-boat.	
	'Mulder is sailing in the jolly-boat.'					
d.	Mulder	segel-t	mit	der	Jolle nach	BlackMesa.
	Mulder	sail-3sgPRES	with	the.MsgDAT	jolly-boat to	Black Mesa.
	'Mulder is sailing with the jolly-boat to Black Mesa.'					
e.	Mulder	segel-t	in	der	Jolle nach	BlackMesa.
	Mulder	sail-3sgPRES in		the.MsgDAT	jolly-boat to	Black Mesa.
	'Mulder is sailing to Black Mesa in the jolly-boat.'					

As is shown, the verb *segeln* 'sail' does not need an argument (5.0.4a). However, the modality of motion is coded by Mulder. He is sailing. Sailing denotes a special kind of motion on water, namely by a boat or in this case by a jolly-boat. A jolly-boat is a non-motorized watercraft with masts, sails and a bottom. This means that the verb *segeln* 'sail' (if it does not entail any arguments) can be considered as a pure manner of motion verb, because it describes a special kind of motion. Furthermore, the verb can be used in connection to a special kind of water craft (5.0.4b, c). In this case, the relevance criteria according to Grice (1975) play a decisive role. The vehicle used when sailing is always included in the meaning of the verb. It is only possible to sail with a watercraft; however, it is unrealistic to fulfill that condition with a spacecraft or with a goods train. If the speaker wants to stress that Mulder used a specific kind of watercraft as in (5.0.4b-e), the vehicle is mentioned. Otherwise, speakers do not stress which kind of vehicle is used. It is possible without further ado to indicate a goal-PP, i.e. a new destination which will be arrived at after finishing the motion process. This has happened in sentence (5.0.4d, e). In this case, the Aktionsart of the verb has alternated, in (5.0.4d, e) the verb is an Active accomplishment. For Activities the following GLS for German motion verbs can be extracted first:

(5.0.5) **do´** (x, [**move.via (α).in (β).manner´** (x, (y)])

It is now necessary to explore how the internal variable (α) is realized by the motion verbs under investigation in the GLS and if this motion is realized at all. How the internal variable (α) is realized in the verbs is presented in (5.0.6):

(5.0.6)	Lieutenant Agathon	is-t	zu Fuß	gegangen
	Lieutenant Agathon	be-3SgPRES	on foot	walk-3sgPART
	Lieutenant Agathon went on foot.			

This sentence is absolutely grammatical in German. In this sentence, foot is used as a means of motion with whose aid it is possible to move from destination A to destination B. If a human being is walking, going, running or sprinting, in terms of motion: to move with their own physical strength from destination A to B, they are forced to apply their feet. This is inherent to the verb *gehen*'go'*;* just as with the verb *segeln* 'sail', i.e. an aircraft or spacecraft has to be applied for flying. Consequently, in regard to the Selectional Properties of the verb *gehen* 'go' and all motion verbs of this type, the internal variable (α), which is realized by the y – variable, is equal to FOOT, while the α-variable of verbs such as *segeln* 'sail' is VEHICLE. This development is shown in examples (5.0.8) and (5.0.6 a – e). As a consequence, the Selectional Properties for the motion verbs *gehen* 'go' and *segeln* 'sail' look as follows:

(5.0.7)	a. *segeln* 'sail'	y = α	α = VEHICLE
	b. *gehen* 'go'	y = α	α = FOOT
	(cf. VVLP 1997: 117)		

Two questions remain at this point: First, how do the motion verbs realize the Active accomplishment reading, secondly, how do the α-variables VEHICLE and FOOT interrelate? In a sentence such as (5.0.6d), the internal variable (α) is represented by VEHICLE. On the other hand, the modality of motion which is achieved by the internal variable (β) is shown. An aim – PP, namely *nach Black Mesa* 'to Black Mesa' is indicated as well. However, this goal-PP does not have to be represented as an internal variable in the GLS. This can be administered by an Activity GLS and by accretion of the according Active accomplishment – component. It looks like this:

(5.0.8) **do´** (x, [**move.via(α).in(β).manner´** (x, (y)]) & INGR **be-at´** (z, x)

Since sentences like *Mulder segelt nach Black Mesa* 'Mulder is sailing to Black Mesa' can be used without the explicit application of a VEHICLE, the y – variable is optional for that variant of the GLS as well. In principle, all of the internal variables are inherently lexicalised with any verb. Apart from the motion verbs under investigation – the α-variables being represented by VEHICLE and FOOT respectively – there is a third group of motion verbs. Verbs such as *krabbeln* 'crawl', *schwimmen* 'swim' or *klettern* 'climb' are converted by a complex interaction of several parts of the body.

A precise semantic and ontological examination of these verbs cannot be achieved in the context of this paper and should be aimed at in future works. Therefore, I will apply the term OTHERS in this elaboration for the α-Variable in the GLS of these verbs. Concerning the GLS of motion verbs it is irrelevant if the α-variable be VEHICLE, FOOT or OTHERS. The conjunction between the α-variables VEHICLE, FOOT and OTHERS is remarked best in the following network:

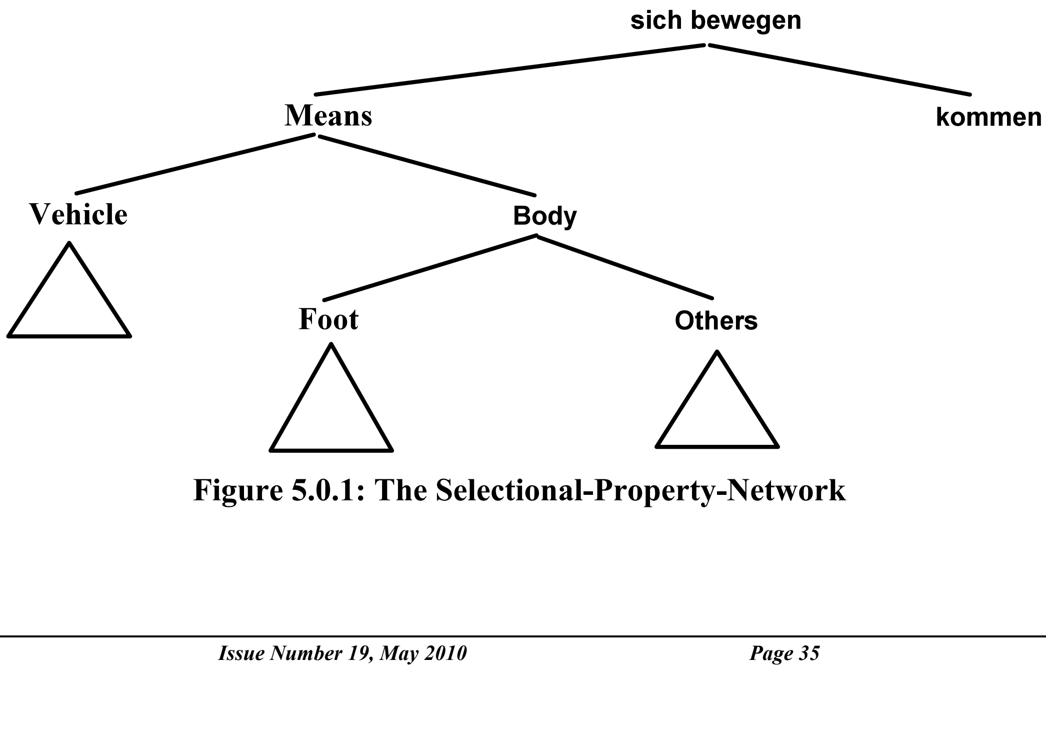

Figure 5.0.1: The Selectional-Property-Network

At first it is important to remark that the Selectional-Property-Network [SPN] is a superior network which is connected with the specific Neighborhood cluster. A neighborhood cluster is a cluster consisting of verbs which belong to a closed domain of very specific verbs. In the case of this study the verbs which belong to the domain of motion verbs which code motion on foot are a neighborhood cluster. The SPN is equal to the notion of district clusters which refer to verbs of a specific lexical category in this case to the motion verbs in general. There are lots of other district clusters for example the district cluster of emotion verbs or of cognition verbs.

District clusters normally contain a variety of neighborhood clusters. The rood node of the network *sich bewegen* 'move' is the abstract node hosting the main concept which is stored in the SPN and two daughter nodes originate from this abstract mental concept. On the right hand side there is the node *kommen* 'come', which diverts from the mother node *sich bewegen* 'move'. On the left hand side the node „means" diverts from the mother node. In the context of this draft, „means" stands for an instrument and describes the means of motion which is internally or externally lexicalized by the verb. This proposal goes back to Mairal's initiative (Mairal p.c.). Means can be realized either by an argument, which is internally and externally lexicalized by the α-variable VEHICLE, or lexicalized by an argument that is equal to the α-variables FOOT or rather OTHERS. As FOOT as well as OTHERS both constitute parts of the body, they inherit some qualities of the body. Thereby the conceptual difference of VEHICLE is revealed. The *kommen* – node in this case represents the most neutral motion verb in German.

Several tests conducted with English and German native speakers have suggested that the language has of verbs which differ from the Manner of Motion Verbs as well, because they are absolutely neutral with regard to the modality of the motion. This is especially present in external realization of the α – variable. In the following I will elaborate on the verb *to go / to come* in English and the verb *kommen* 'come' in German.

(5.0.9) a. Mulder went / came to Quantico by helicopter / on foot / by car.
a'. Mulder geht zu Fuß / *mit dem Helikopter / * mit dem Auto nach Quantico.
b. Mulder flew to Quantico by helicopter / *on foot / *by car
b'. Mulder kommt zu Fuß / mit dem Helikopter / mit dem Auto nach Quantico.
c. Mulder went /came to Quantico.
c'. Mulder geht nach Quantico.

The sentences in (5.0.9) represent the semantic differences between the verbs *to go / to come* and *gehen* 'go' / *kommen* 'come' in English and German respectively. Sentence (5.0.9a) proves that the verbs *to go* and *to come* are neutral enough to be applied in connection with the α-variable VEHICLE as well as with FOOT. Furthermore, they can be used without external realization of the internal variable α, for instance in (5.0.9c). The example in (5.0.9 b) on the other hand shows that the English verb *fly* can only be used with flying objects, e.g. helicopters or air planes. English Manner of Motion Verbs, such as *drive, sail* or *bike,* behave similarly. An external realization of the α-variable VEHICLE with the verb *fly* is possible in connection with a flying object only.

In German, *kommen* 'come' is the more neutral verb, as proven in sentence (5.0.9b'). The external realization of the internal variable α, which is represented by Means, can be chosen freely in connection with *kommen* 'come', similar to the English verb *to go /*

to come. But the term *gehen* 'go' in German is definitely a Manner of Motion Verb. Here, the α-variable can exclusively be realized with FOOT, as shown in sentence (5.0.9a‘). Sentence (5.0.9c‘) presents another quality of the verb *gehen* 'go'. If the internal variable α, which is restricted in connection with FOOT, is not realized externally, the sentence becomes ambiguous. As a result, for a native speaker of German the sentence (5.0.9c‘) could mean that either Mulder really went to Quantico by foot even if he was before staying in his apartment in Washington D.C., which is almost 36 miles far away from Quantico, or it could mean that Mulder let himself be barracked in the Marine Corps Base Quantico. However, in English sentence (5.0.9c) is absolutely neutral. The sentence simply expresses that Mulder was somehow moving to Quantico. How he is able to do that is not lexicalized. With the aid of this GLS and the Selectional Properties developed above, it is now possible to create Lexical Fingerprints for the specific domain of German motion verbs.

It is worth mentioning that the SNP is not universally valid in all languages. There are lots of languages which do not show this pattern of realization. In Russian, Ukrainian, Polish and Czech for example there is no neutral verb like *kommen – to come* or *to go.* Rather all kinds of motion have to be realized with specific verbs of motion. However, this is no consistent pattern within Slavic languages, as Bulgarian follows the German pattern (Swirgun p.c., Bontcheva p.c).

5.1 Lexical Fingerprints of German motion verbs and the construction of an inheritance network of these verbs

The concept of semantic inheritance networks, which create a hierarchic structure, is based on the principle of hyponymy. Therefore, one can infer that general lexical units are no random amounts, but rather they form dimensions and sub-dimensions. With regard to motion verbs these can be described by parameters which are significant for that verb domain (cf. Mairal und Faber 2005: 9). I have analyzed the lexical definitions of the analyzed verbs using the definitions in the Brockhaus-Wahring. In addition I have asked several native speakers of German.

By assigning the FOOT-Domain, it has been explained at first how the α-variable of the GLS is internally lexicalized or externally realized. The internal lexicalization of the β-variable then results from this analysis. This means that the Manner of Motion is lexicalized by the β-variable of the GLS. As a consequence, the following paraphrasing of the β-variable as well as of the Manner of Motion results from the decompositional analysis of the verb domain:

(5.1.1)

a. *gehen* ‘go’: normales Tempo sich zu Fuß bewegen.
‘to move on foot with a normal speed.’

b. *rennen* ‘race’: schnelles Tempo sich zu Fuß bewegen & mit kurzen festen Schritten & kurz vor Sprint
‘to move on foot with a fast speed & to move with short firm steps & almost sprinting’

c. *laufen* ‘run’: schnelles Tempo sich zu Fuß bewegen & leicht springend.
‘to move on foot with a fast speed & slightly jumping.’

d. *marschieren* ‘march’: normales Tempo sich zu Fuß bewegen & über weite Entfernungen & gleichmäßig in geschlossenen Reihen.
‘to move on foot with a normal speed over far distances & to move regularly in closed alignments’

e. *schlendern* ‘amble’: langsames Tempo sich zu Fuß bewegen & behaglich
‘to move on foot slowly & on easy‘

f. *spazieren* ‘walk’: langsames Tempo sich zu Fuß bewegen & zur Entspannung
‘to move on foot in a slow speed & for relaxation’

g. *sprinten* ‘sprint’: sehr schnelles Tempo sich zu Fuß bewegen & mit höchstmöglichem Tempo & Grenze der Belastung
‘to move on foot in a very fast speed & with the most possible speed until the limit of the burden’

h. *wandern* ‘hike’: normales Tempo sich zu Fuß bewegen & über weite Entfernungen & mit Marschgepäck.
‘to move on foot with a normal speed & over far distances & with backpack’

i. *waten* ‘wade’: langsames Tempo sich zu Fuß bewegen & durch flüssige Umgebung.
‘to move on foot & through liquid surroundings & with a slow speed.’

j. trotten ‘plod’: sehr langsames Tempo sich zu Fuß bewegen & schwerfällig.
‘to move on foot slowly & with heavy footfalls

Based on these decompositional analyses of the β-variable, it can be recognized that German motion verbs have various conceptual dimensions (cf. Mairal und Faber 2005: 11). The most important dimension, which can be identified with the aid of the decompositions in (5.1.1), is: [± velocity]. Furthermore, the individual semantic qualities of each motion verb have to be added. If these dimensions are considered, the verbs can be divided into categories which assign them the current speed. With the verbs *trotten* ‘plod’, *schlendern* ‘amble’, *spazieren* ‘walk’, *laufen* ‘run’, *rennen* ‘race’, and *sprinten* ‘sprint’ the speed of motion increases, and the verbs are specified by additional qualities.

The verbs *wandern* ‘hike’ and *marschieren* ‘march’ are exceptions. Their speed is slow or neutral. The verb *waten* ‘wade’ cannot be classified easily. The motion is slow, but this has to do with the outer circumstances, namely it is necessary to move through a liquid surrounding; as a consequence, the person is forced to move slowly.

It is noticeable that the verb *gehen* ‘go’ is the semantically emptiest and most neutral verb. Neither does it have any further specific qualities. It can only be decomposed as in sentence (5.1.1a). Owing to the assignment of the binary feature, it is possible to establish the decompositionally different significance of the verbs.

(5.1.2)	a. *gehen* ‘go’	[± velocity]
	b. *rennen* ‘race’	[+ velocity]
	c. *laufen* ‘run’	[+ velocity]
	d. *sprinten* ‘sprint’	[+ velocity]
	e. *spazieren* ‘walk’	[- velocity]
	f. *schlendern* ‘amble’	[- velocity]
	g. *trotten* ‘plod’	[- velocity]
	h. *wander* ‘hike’	[- velocity]
	i. *marschieren* ‘march’	[- velocity]
	j. *waten* ‘wade’	[- velocity]

At this point it is necessary to emphasize that these binary features define a speed spectrum and a distance spectrum. With the aid of a binary decomposition a few semantic specifications can be explained, but the productivity of the binary feature semantics is very restricted. As a result, there is a ill-defined spot in the cognitive concepts of human beings which defines a transition between fast vs. slow on the one hand and far distance vs. short distance on the other hand. However, with the aid of the binary features a rough classification of the verbs can be carried out which makes it possible to divide the verbs into macro classes within their Neighbourhood – Cluster. It is noticeable that the verb *gehen* ‘go’ is not easily to be classified in terms of binary features, and therefore it has the feature [± velocity]. The verb *gehen ‘*go’ is able to define a relatively fast motion, in contrast to the verbs *laufen* ‘run’, *schlendern* ‘amble’ and *trotten* ‘plod’. This is proven in the sentences *Max ist schnell gegangen* ‘Max has gone fast’ and *Max ist langsam gegangen* ‘Max has gone slowly’.

Both are accepted by German native speakers, because *gehen* ‘go’ does not inform about the lexicalisation of the speed. However, the verb *gehen* ‘go’ is not the semantic primitive of the whole German motion verbs domain - this is namely *sich bewegen* ‘move’*,* but it can absolutely be considered as a primitive of the Neighborhood – Cluster FOOT. So there is a primitive of the district cluster, in this care *sich bewegen* ‘move’ and a primitive of a neighborhood cluster. This is due to the fact that it has the semantic [± velocity].This is the reason why, in comparison to *sich bewegen* ‘move’, it effectively is a primitive of the second order [PSO]. Owing to the fact that it is a semantic PSO, *gehen* ‘go’ creates the root node of German motion verbs of the FOOT – domain. It is also directly connected to the FOOT – node in the SPN. These feature results from the comparison to verbs like *wandern* ‘hike’ and *marschieren* ‘march’. These node definitions are about Lexical Fingerprints.

At first, it is necessary to mention that primitives of Neighborhood – Clusters (therefore PSO’s) do not have a Manner – Quality within the framework developed here. The Manner – Quality defines idiosyncratic verb qualities. Due to the fact that a PSO is semantically almost empty, it has no Manner – Qualities. This is the reason why a PSO always has the following reference point on its Manner – Qualities inside of the created framework: <manner of motion> = = PSO Ţ β = Ø. In this network, the PSO *gehen* ‘go’ instead inherits all relevant qualities from the FOOT – node, which on the other hand inherits from its mother node inside of the SPN, which is the primitive of the motion verb domain *sich bewegen* ‘move’.

If a verb inherits all qualities of its predecessor node, this can be represented within a fingerprint by the expression < > = = predecessor.[3] In this case, the predecessor is a variable which can be replaced by the name of the relevant predecessor. As the root node of a specific verb network, the PSO contains in its fingerprint the basic information about the Selectional Properties [SPs] of the verb domain, which are thereby inherited by the daughter nodes. The SPs indicate content of the variables of the GLS. In case of the verb domain examined here, the SPs look as follows: $y = \alpha$ Ţ FOOT ʼn β = <manner of motion>. This means that the internal α-variable is equal to the external y variable. It is satisfied by FOOT and it can potentially be externally realized. The β-variable in the GLS is satisfied by the reference point <manner of motion> of the particular verb. Consequently, it is also a kind of variable, or in this case, it forms a reference point within the particular fingerprints. It is possible to refer to this behavior as local inheritance within a node, or rather a fingerprint.

I define verbs which are direct daughter nodes of the PSO in a network as basic verbs. Basic verbs at first inherit from the superior ontological description node. This node is called ontological description node as it is connected to a world ontology which describes its features in detail. Ontological description nodes have fingerprints, too, which describe their semantic features. As the ontology is based on binary features and in case of motion verbs the most relevant binary feature is [± velocity] there is only one ontological description node mentioned in this framework however if there was a more fine grained semantic description of these verbs there could in principle be more such nodes.

However the world ontology of the ontological description nodes is not part of the inheritance network developed in this paper. Basic verbs usually inherit all qualities from these nodes. In the case of this networks ontological description nodes are [+ velocity] and [- velocity]. Furthermore, basic verbs have second characteristic: They inherit the Selectional Properties from the root node, which is the semantic primitive of the particular domain and therefore the PSO. Since the semantic qualities of the PSO are not passed on to the ontological description node, the inheritance quality inside of this specific network is expressed by the reference point <selectional properties> = = gehen.

This can be understood as a global inheritance which is able to skip nodes, in this case the ontological description nodes. Furthermore, basic verbs contain the reference point <manner of motion>, where their idiosyncratic qualities are determined. The daughter nodes of basic verbs inherit all qualities from their mother nodes, but these sub verbs have their own idiosyncratic qualities as well. This is the reason why they require a <manner of motion> - reference point, where the qualities of these references, inherited from the basic verb, can be over-written.

At this point, the role of non-monotonic inheritance is made clear. The verbs with most idiosyncratic qualities are farthest below in the hierarchy of this network. It is possible to determine the following fingerprints for the examined verbs:

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[3] The structure of the Lexical Fingerprints orientates itself to DATR (cf. Evans und Gazdar 1996). The terms global heritage and local heritage orientate themselves to DATR as well.

(5.0.3)

gehen ‘go’:
< > = = FOOT
<selectional properties> y = α Ț FOOT ’n β = <manner of motion>
<manner of motion> = = PSO Țβ = Ø

laufen ‘run’:
< > = = [+ velocity]
<selectional properties > = = *gehen* ‘go’
<manner of motion> = = a bit jumping

rennen ‘race’:
< > = = *laufen* ‘run’
<manner of motion> = = with short steps & short of sprinting

sprinten ‘sprint’:
< > = = *rennen* ‘run’
< manner of motion> = = fastest velocity possible & limit of capacity

spazieren ‘walk’
< > = = [- velocity]
<selectional properties> = = to go
<manner of motion> = = for recovery

wandern ‘hike’
< > = = [- velocity]
<selectional properties> = = to go
<manner of motion> = = with field kit

marschieren ‘march’
< > = = [- velocity]
<selectional properties> = = to go
<manner of motion> = = in a group & even in closed rows

schlendern ‘amble’:
< > = = *marschieren* ‘march’
<manner of motion> = = at ease & slow

trotten ‘plod’:
< > = = *schlendern* ‘amble’
<manner of motion> = = very slow & with heavy foodfalls

waten ‘wade’:
< > = = *trotten* ‘plod’
<manner of motion> = = in liquid environment

Based on these fingerprints, it is possible to identify the primitive *gehen* ‘go’ as well as the basic verbs *laufen* ‘race’ *spazieren* ‘walk’, *wandern* ‘hike’ *marschieren* ‘march’. The other verbs are sub verbs.

On basis of these fingerprints it is possible to create the following inheritance network:

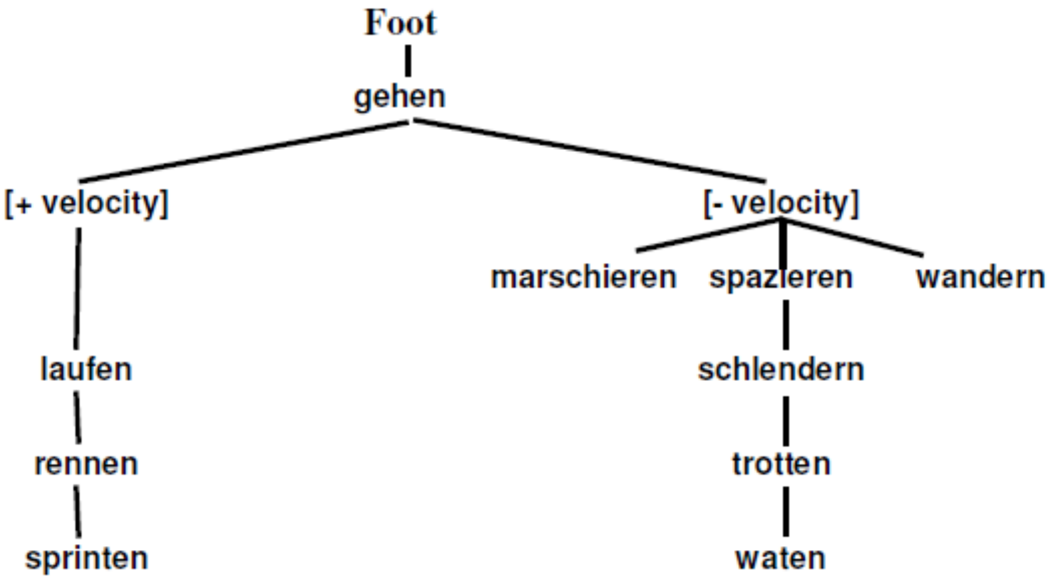

Figure 5.0.2: The inheritance network

5.1.1 Inheritance Network for German motion verbs

As can be seen figure 5.1.1, the feature [± velocity] is the relevant distinctive binary feature in the network. The nodes [+ velocity] and [- velocity] are daughter nodes of the PSO *gehen* 'go'. However, their status is different from the verb nodes. They are ontological inheritance nodes, connected to the conceptual world ontology mentioned before. As I have laid out before, the basic idea of basic verbs is that they inherit directly from the ontological description nodes. In addition, they have the least idiosyncratic qualities within their tree structure path. The verbs *spazieren* 'walk', *wandern* 'hike', *marschieren* 'march' and *laufen* 'run' and therefore are basic verbs according to the fingerprints shown. *Spazieren* 'walk' has been identified as a basic verb, because most German native speakers agree that *spazieren* 'walk' is a slower motion than *laufen* 'run' *rennen* 'race' or *sprinten* 'sprint'.

However, verbs which have the features [+ velocity] are graded in ascending order according to their speed. Accordingly, the basic verb describes the verb with features which define the slowest motion. A special quality is presented on the verbs which belong to the group of verbs inheriting from [- velocity]. Verbs that have these features are stored in a down-ward speed, i.e. the speed within this inheritance network gradually decreases from the basic verb to the final verb in a tree structure path. What is special with the verbs which follow the node [- velocity] is that the verbs *spazieren* 'walk', *wandern* 'hike' and *marschieren* 'march' have nearly the same velocity.

The difference between these verbs are their idiosyntatic features but in the case of velocity they have the same range. Therefore all of these verbs are basic verbs. However verbs like *schlendern* 'amble', *trotten* 'plod' and *waten* 'wade' inherit from *spazieren* 'walk' as they are semantically closer to this basic verb than to *wandern* 'hike' or *marschieren* 'march'.

It is now necessary to question how the networks developed are linked to the SOA – network and to the network of the Aktionsarten. It is also necessary to explore how the alternation of motion verbs can be explained without using the lexical rules which apply in the workshop, but in using the inheritance hierarchies which apply in the mental lexicon on their own. At first, the linking of the networks is shown in figure 5.1.2

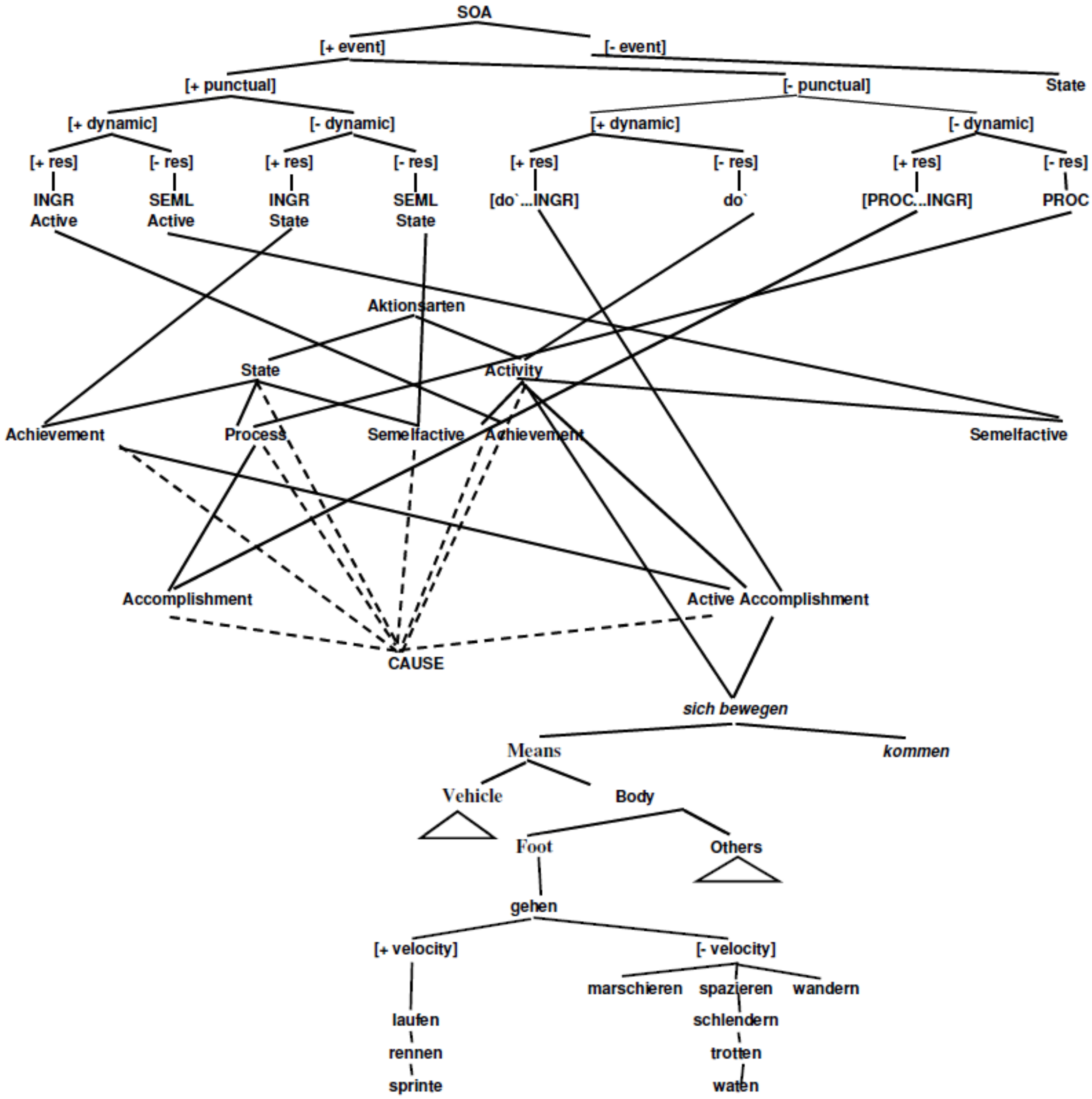

Figure 5.1.2 Complete Inheritance Network

Figure 5.1.2 allows for an overview of the whole architecture of the mental lexicon for RRG. It is important to emphasize that the SOA – network and the networks of the Aktionsarten are networks which are universally valid for all languages. It should be the aim of further research work to identify how the cross linguistic division of Aktionsarten is defined. It is determined for SPNs that they are language specific as well as that a great amount of these networks exist. For instance, Mairal and Faber indicate 10 lexical domains of verbs (cf. Mairal und Faber 2005: 5). The Neighborhood – Clusters which are connected with such SPNs are language specific as well. It is currently neither possible to say how many and which SPNs and Neighborhood – Clusters a language has, nor if their structure is universally valid. However, with the construction of the SPN of German motion verbs it has been shown that it is possible to suppose that a SPN of English motion verbs disposes of a similar structure. The inheritance networks are all linked together. The *gehen* – node of the Neighborhood – Cluster of the FOOT – domain is connected with the FOOT – node.

The linking of the Aktionsart network plays a decisive role with the *sich bewegen*– node of the District-Cluster MOVEMENT. As is presented in figure 5.1.2, this node is directly linked with the nodes Activity and Active accomplishment in the Aktionsart network. This linking renders the use of lexical rules in the workshop unnecessary. If the sentence *Scully geht zu Fuß zum J. Edgar Hoover Building* 'Scully is going on foot to the J. Edgar Hoover – Building' should be pronounced, the LS in the Aktionsart network taken from the LS of an Active accomplishment is chosen in this framework. They look like this: **do´** [x, (**predicate$_1$´** (x, (y))] & INGR **predicate$_2$´** (z, x) or (y). The root node of the SPN also disposes of a fingerprint, similar to that of motion which I have described in this part of the paper. Nevertheless it is very complex, because it contains a semantic description of the concept of *sich bewegen* 'move', which I have not developed in this paper.

The concept of *sich bewegen* 'move' is displayed in the GLS of the District-Cluster MOVEMENT. The concept now disposes of a PP-Assignment-Principle [PPAP] in its fingerprint: "When occur as an Active accomplishment, substitute **be-at** for **predicate$_2$´".** The PPAP gives out the order to replace the variable **predicate$_2$´** by **be-at´**, if the verb which should be expressed in a fixed morphosyntactic context appears as an Active accomplishment. Because of the application of this principle it is unnecessary to assume a basic Aktionsart, as was argued for in VVLP (1997) und VV (in press).

The PPAP can be determined for other kinds of verb alternations as well. In a cluster where the consume verbs, e.g. *essen* 'eat' or *trinken* 'drink' would appear, the principle would be pleasantly assumed and would for instance read as follows: "When occur as an Active accomplishment, substitute **consumed´** for **predicate$_2$´**." In this framework, no lexical rules describe the alternation of the Aktionsarten in the workshop anymore. Instead, this is now a purely lexical process.

Processes taking place in the workshop are now merely such which cannot be motivated by the created networks owing to their networking. It should be the aim of future research work to create the internal structure of the workshop and to describe its interaction with the lexicon.

6. Conclusion

This account of a mental lexicon for RRG has shown how the internal structure of the lexicon module can be captured with the help of multilayered inheritance networks. It was exemplified that verbs in the lexicon have only one single lexical entry for each verb instead of basic Aktionsarten. It was further shown that lexical rules do not apply in this model of a mental lexicon and that many processes regarding verb alternations which have been sourced out to the workshop are actually lexical processes.

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