

# Knowledge Representation in Dictionaries\*

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## 0. Introduction

The organizers of this conference must have had their own reasons for inviting a linguist to say something about dictionaries. If I may guess why, I can think of two reasons. Firstly, they know that I belonged to a team of four linguists setting out to make the counterpart of the Dutch Big Van Dale, our leading dictionary.<sup>1</sup> From scratch we made a blueprint called *Opzet* (Design) of 68 pages, on the basis of which a full-fledged dictionary can be produced. However, at the very moment the large team of entry-authors was installed to write the lexical entries on the basis of the script, the economic recession in 1981 made it painfully clear that the Dutch language community cannot or does not want to afford two top dictionaries: twenty million speakers is probably too little for having two dictionaries of the Big Van Dale size. The second reason must be that last year I wrote a long, very critical review article about the new edition of the Big Van Dale. These two things taken together put me in the position of a sour music critic having written a symphony that has never been performed. It wouldn't help to observe that in the history of architecture there are many more designs than buildings and that yet these designers are called architects.

So I have to appeal to a third reason: I started as a generative linguist, but gradually I have diluted-down into a semanticist employing the tools of mathematical logic for my work on quantification and temporal structure. Combining the three, I shall address you as a constructive and critical semanticist.

## 1. The five C's

Let me first briefly discuss the five criteria for judging definitions and register labels of monolingual dictionaries, because some of them show up in what I am going to say. I will call them the five C's: completeness, consistency, correctness, currency, and citation. In my review I identified them with the help of a relatively small knowledge domain: chess. This served as a revealing sort of model for testing the criteria applied to the dictionary information about structured knowledge domains like logic, mathematics, law, physics, medicine, economics, music, among others.

*Completeness* can be taken globally and locally. Global completeness is rather uninteresting from the definitorial point of view, because the size of dictionaries is determined by the publisher or by other practical nuisances. No, completeness is to be understood here primarily in its local sense. If you include *horse*, then the structure of the chess game domain requires that *king*, *queen*, *rook*, *bishop* and *pawn* also be included. So, you are incomplete if you tell what naturals, integers and reals are, but you forget the rationals. I pointed out that in general Van Dale failed to have this sort of completeness in all sorts of important knowledge domains. I am not going to repeat my review of Van Dale here. What I say, applies to many many foreign dictionaries as well, but in this talk the completeness criterion will not be at issue.

*Consistency* is a very interesting criterion. Van Dale gives appropriate information about the moving of bishops along the diagonals but it restricts itself for *horse* to: name of a piece of chess. This is not consistent. It reveals the lack of a coherent point of view organizing the definitions of the chess pieces. Sometimes Van Dale gives the form, sometimes the movement, sometimes the importance of the pieces. In this respect, Webster College is really excellent: as a chess player you feel that the definitions were checked by someone who knows the game. Petit Robert is somewhere in between.

*Correctness* comes into play in different ways. One may not ask the impossible so one may accept definitions which can be located between a lower limit and an upper limit. 'Name of a chess piece' is far below the lower limit for the definition of *horse* in a chess game. It gives practically no information: no dictionary would think of defining poem as 'Name of a literary expression form'. On the other hand, you do not learn the chess game by reading a dictionary. This attitude seems to be a reasonable way of judging a dictionary, although the size of the dictionary is, of course, a factor in fixing the lower and upper limit. Compatibility is a catch word

here: a definition must be compatible with the meaning which experts of the relevant domain standardly attach to it. Correctness could also be used in judging information which is unnecessarily too vague and too broad, as is the case with the meaning of many labels.

*Currency* is a funny thing. Some dictionaries take a range of about hundred years for the meaning description of words. However, you cannot always freeze the use of words. In Dutch, we have two names for *bishop*: *loper* (lit: walker) and *raadsheer* (lit: councillor). Likewise for the rook we have the pair *toren* (lit: tower) and *kasteel* (lit: castle). Generally, only people having the age of sixty and older will use *raadsheer* and *kasteel*. These names are dying out. People in their fifties and younger always use *loper* and *toren*. Currency means that it is quite odd to still have the definitions under *raadsheer* (councillor) and *kasteel* (castle) rather than under *loper* (walker) and *toren* (tower).

Finally, *citation*. I could have skipped it here, but a fact of life is that many dictionaries fill a lot of room by quoting literary authors, not so much I am afraid because this gives information about the meaning of a specific word, but rather as a sort of signal to linguistics: 'Keep your hands off. We, lexicographers, have a very respectable philological background and mission: we foster the cultural treasures of the past.' But *cultural* is taken in Van Dale as 'literary', which results in quoting a writer rather than a mathematician for the illustration of a notion like transitivity. And this leads to the wrong meaning explanation.<sup>2</sup>

How strict these criteria should be applied, depends of course on the room for definitions in the dictionary. Focussing on a range between about 2000 pages (Oxford Advanced, Duden, Petit Robert, Garzanti, Felice/Duro) and 4000 pages (Van Dale) one may accept that in smaller dictionaries the descriptions are reduced to simple indications like 'chess piece', but in that case it is better not to do what the majority of smaller dictionaries does: to define the knight as having the form of a horse's head and the bishop on its diagonal move. Of the five criteria, consistency is indeed the least dependent on size and it is the most urgent one at the moment. It is extremely easy to find inconsistencies. Until the late eighties, one cannot really blame anyone for this: they are due to the dreadful filing cards of the past and the impossibility for any human being to remember all information written on them. This situation has been changed quite rapidly due to technological improvements, and it is still changing. This makes consistency a very important criterion indeed, because in this transitory phase dictionary entries and labels have to be checked and

rechecked on consistency.<sup>3</sup> The problem is that most lexicographers cannot start from scratch and have to repair the boat while sailing.

I talked about our linguistically based design and I am sure we would have beaten many dictionaries including Van Dale in terms of the five C's. If you start from scratch, it is easier to remain consistent, complete, correct, etc. But after some reflection I must admit that this is probably not a virtue of the linguistic part of the design. At the time, linguistics still hated semantics. So being semantically interested, what we did in determining for example the general format of verbal information, was to use the then—and in Chomskyan circles still—peripheral localistic framework of Gruber and Jackendoff, with a little Fillmore in it. A glance at the current literature is sufficient to observe that linguists (and not only generative linguists) still cannot deliver the goods as requested. As long as they do not reach consensus about whether there are four verb classes (States, Activities, Accomplishments, Achievements) or three (States, Processes, Events), or as long as theories change the picture completely every seven years, it is hard to see how lexicographers could possibly apply anything.<sup>4</sup>

## 2. The Message

Here, I think, I should reveal something more of the message I would like to convey at the level of generality at which I am allowed to speak. You are in Holland, so you are supposed to receive a Message.

As you all know, lexicography has started as part of the philological reconstruction of the past: people were interested in the meanings of the words spoken and written by their ancestors, and it was only later that dictionaries were made to register current meanings. Philology, at least in the Dutch sense, is a sort of (literary) reconstruction of worlds (domains) in which language is being interpreted: sentences are looked at, given a domain of interpretation, at a certain point in time and by relating them systematically to the world in which they were used, one may determine their meaning. In this enterprise, it is vital to lay down how words as the building blocks of sentences were being used in different contexts. If you remove the restriction to the study of literary history, this characterization of philology is nothing but the general definition of model theory as developed in mathematical logic and successfully applied in current semantics: it develops means for constructing and reconstructing models in which expressions can be interpreted.

Now, the Message itself: being a part of semantics, lexicography is in the process of being mathematized, irreversibly. It cannot escape from this development because the foundations of a good lexicographic description are completely definable by mathematical-logical concepts such as consistency, completeness, correctness, etc.<sup>5</sup> Lexicography is focussed on connecting language with the world in which this language is being used and by doing this it falls right in the scope of model theory, much to its profit I would like to add.

Let me first save myself from being sold a dummy. Nowadays, every lexicographer will admit that no serious dictionary can be made without computation and that countless improvements in the quality of information processing are due to this development: the computational tools contribute to a much better overall organization of dictionaries by providing for data bases in which lexical information is stored and on the bases of which dictionaries can be made. For the organization of data bases mathematical-logical notions are indispensable. The dummy is this. Some lexicographers having said this in a genuine mood, will hire technical experts to take care of this part of the job. It would leave them the room to stick to their good old definitions and labels and to keep away from formal semantics.

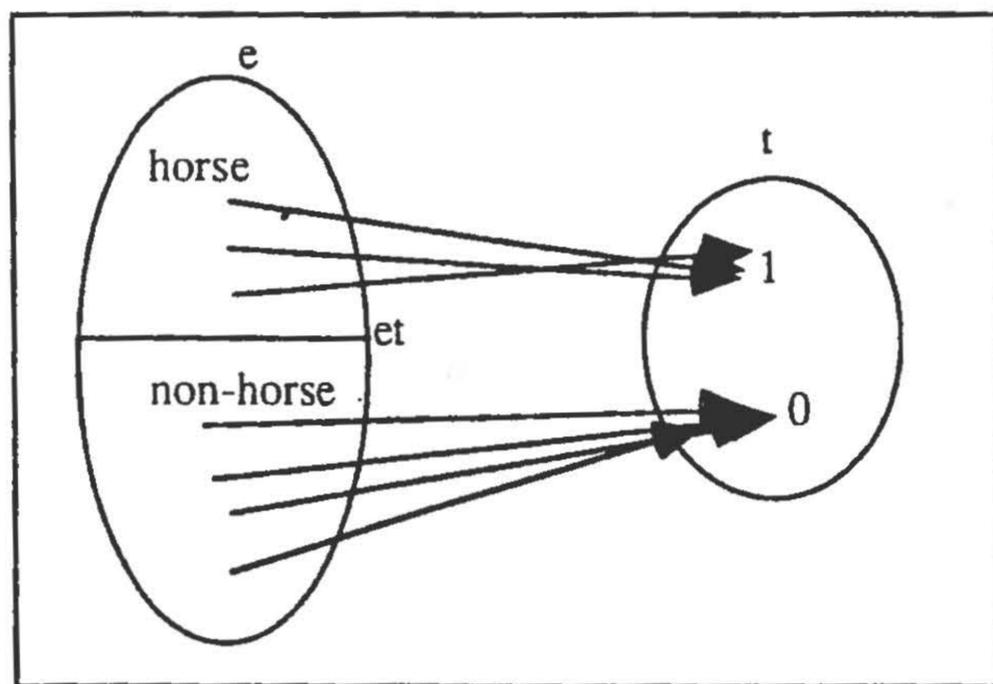
My point is that parallel to and concurrent with the technical improvements in the area of information processing, storage and retrieval, mathematical-logical tools also play an increasingly dominant role in obtaining adequate definitions and labels. Of course, lexicographers should not be turned into mathematical logicians. They are in a very fortunate position of being able to make practical decisions about seemingly endless and tiresome discussions of theoretical issues, so they can use what is available as a practical tool. Considerable improvement of the definitions can be made by applying elementary set-theoretical algebraic notions. Not in the definitions themselves, but in a reliable check on the definitions. I will demonstrate this point here today with the help of an investigation of a register label and I will tie it up with a sort of theoretical model for the design of definitions, also in view of a second Message that I want to convey at the end of my talk.

### **3. Sets as functions**

The mathematical logician Richard Montague contributed (at least) two important insights to semantics. The first one is that a set can be equated

with a specific sort of mathematical function construing it. The second is that sets can be made dependent on indices.

As to the first, let us capitalize on the fact that a property, say HORSE, may be described at least in terms of all the things that have this property. In this way, the world about which we speak (at a certain index, which we keep fixed here) is divided in those things that are called *horse* and those things that are not horses. A lot of philosophy can be thrown in, because sometimes you cannot determine whether or not things are horse. But these qualms shouldn't worry the lexicographer. Why should they burden the dictionary with the scientific problems of biologists concerning the fault between horses and non-horses. So, they operate on the safe side and can see a set as construed by a (mathematical) function which has the form of Figure 1. This function is a domain splitter: it separates things that are horse from those that are not.



*Figure 1*

Most of the categories you describe in the dictionaries can be treated in this way.<sup>6</sup> Your whole existence as a lexicographer—categorizing and subcategorizing things—is based on this sort of splitting, so why not express it formally, if it helps you to improve on things?

There is an attractive sort of ontology in Figure 1. Individuals are marked as *e* (entity), the values 1 and 0 as *t* (truth) and the function mapping individuals to 1 or 0 as *et*. The algebra we need is simple:  $et(e) \Rightarrow t$ . That is, *et* applied to *e* yields *t*. So, you have function *et* and for all arguments of the type *e* of individual, the result will be one of the truth values *t*. Truth is a very practical guide indeed: it helps organizing things into two regions: a set and its complement. Both are also of type *et*: you

can say that a set is nothing but the result of splitting a domain such that the set and its complement are formed.

The second point made by Montague is that sets (or if you wish, the splitting functions) can be made dependent on indices. For example, the set of horses at this moment (or more general: an arbitrary index  $n$  pertaining to some context) is different from the set of horses say on Tuesday last week (or an index  $n-1$ ), which means that technically you need a function operating on indices yielding the sets of horses at any relevant index. Each of the three circles in Figure 2 can be replaced by Figure 1 with possibly different values for the individuals  $e$ .

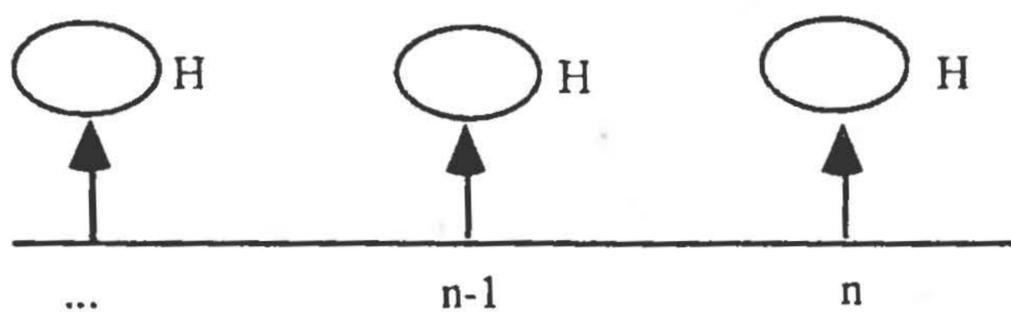


Figure 2

Index-dependency comes already much closer to the property of being a horse. Moreover, it enables to bring in all sorts of partial information, such as context restrictions, pragmatic factors, etc. The index machinery covers the intuitive notion of sense, that is so dear to lexicographers. Of course, this is not the whole story, but you certainly will accept the point of departure: you have the property of being a lexicographer and this must have something to do with the simple fact that here and now you constitute an indexed set of people called lexicographers, some of which are connected to earlier Euralex-indices.

#### 4. The L-model

Verkuyl (1978) proposed a model, call it the L-model, for the construction of a mental lexicon in which information associated with a particular lexical item, say *horse*, is structured as in Figure 3. Its entry in the lexicon  $L$  is split up in:

- a component  $N$  in which a lexical item *horse* is biconditionally connected with a concept HORSE by an interface predicate *Is\_called\_*, which assures that  $x$  is called a horse if and only if  $x$  is a horse.
- a component  $C$  containing if-then rules, whose consequents are spelled out in other entries, as illustrated for  $P(x)$  in Figure 3.

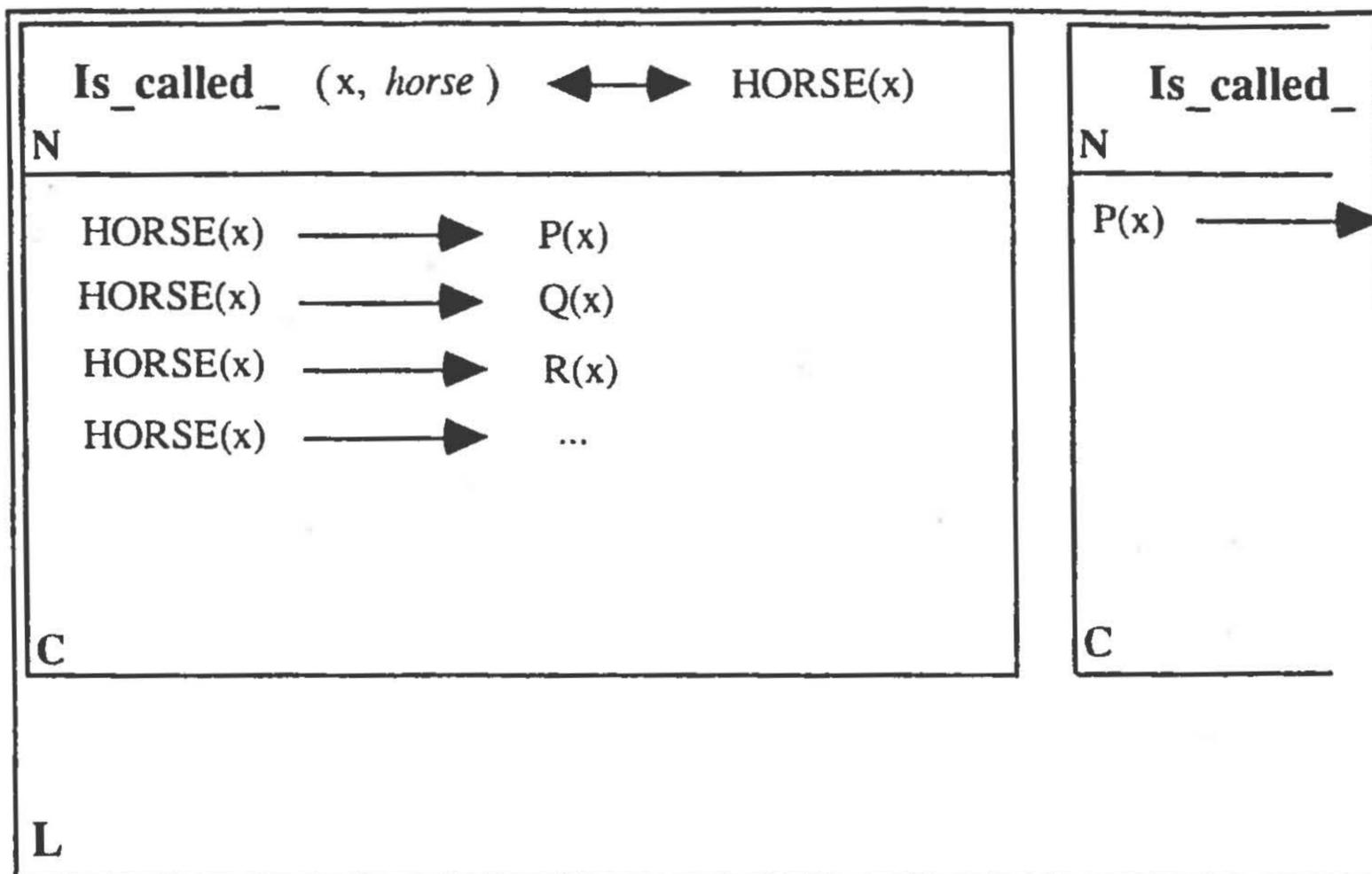


Figure 3

The name-giving component **N** assigns a unique name to a concept (I don't believe in complete synonymy), in this case the concept HORSE, which is interpreted as a function construing a set: HORSE in **N** denotes the domain-splitting function of Figure 1. In **C** it is characterized as to the conditions an entity  $x$  should have in order for it to be mapped to 1 rather than to 0.

The top rule in **C** requires that if Alice is a horse, Alice has the property  $P$ . Say  $P = \text{MAMMAL}$ , then in **L** there will be an **N**-entry connecting the Dutch noun *zoogdier* (the English *mammal*) to the concept MAMMAL, which in **C** is related to the concepts ANIMAL and NURSE\_WITH\_MILK, by rules like:<sup>7</sup>

$$\text{MAMMAL}(x) \Rightarrow \text{ANIMAL}(x)$$

$$\text{MAMMAL}(x) \Rightarrow (\text{NURSE\_WITH\_MILK}(x,y) \ \& \ \text{OFFSPRING}(y,x))$$

So, there are two steps between *horse* and *animal*, as in Robert. Some dictionaries, like Webster and Cobuild, give 'animal' rather than 'mammal'. This is not excluded in the **L**-model, but it remains very close to the well-known technique of *genus proximum et differentiae specifi-cae*. There is no need to give an exhaustive list of properties of HORSE because the *if-then*-structure of **C**-rules replaces the bi-conditionality which was so heavy a burden for the philosophers and decompositional

theorists.<sup>8</sup> The unconditional arrow gives just partial information about a concept (the antecedent) and relates it by the information in the consequent to the whole system of concepts that forms the knowledge base, because all consequents have their own antecedent position. In this way, the L-model remains quite close to the needs of the lexicographer: just a couple of inclusion relations for the kernel of the meaning and the rest of the knowledge is found via the defining terms, when necessary or allowed by the number of pages available.<sup>9</sup>

I am not selling you a model here. There are so many more newer models for sale in the literature that I am sure you will not buy a 1978-model. Yet, it stroke me as handy for the explication of the general points I would like to make, the more so, because the editor-in-chief of the WNT—the mother of all Dutch dictionaries—supports the view that:<sup>10</sup>

... the word meaning is the lexical concept connected with the word form. Herein the distinction between linguistic and encyclopaedic knowledge data is dissolved. However, a concept is never on its own, but it is connected with other concepts in a conceptual structure.

This applies to the L-model, but the quote is not about it. It is a support for the so-called cognitive semantics. But for some incomprehensible reasons cognitive semanticists seem to hate sets.<sup>11</sup> So, there is some cognitive dissonance around here. I will return to this declaration of love in the quote after having demonstrated how concepts can be sensefully connected with sets.

## 5. The label <figurative>

I will now first apply the L-model to the analysis of <figurative>. The use of this label in Van Dale is quite misleading, as it is in the foreign dictionaries that use it.<sup>12</sup> Let me begin with a related label which in the first post-war edition of Van Dale restricted one of the senses of the word *jood* (jew) in (1):

- (1) (oneigenlijk) woekeraar, afzetter, bedrieger ...  
(not proper) usurer, swindler, impostor

The interpretation of <oneigenlijk> ( $\approx$  not literal, proper, actual) as a label poses a problem haunting virtually every dictionary: labels are not properly defined. In virtually all cases one has to find their meanings in

the lexical entries themselves. This leads to vague, useless and uninformative circumscriptions, as you can see in (2).

(2) not taken in a proper, real sense, figuratively, metaphorically.

Are the three explanations in (2) synonymous? No, they are not: *not taken in a real sense* is not the same as *figuratively*, and *figuratively* is not the same as *metaphorically*.

Some people are inclined to take <oneigenlijk> as <figurative>. This would (1) give the status of the entry for *juif* in the 1985-edition of Grand Robert in (3), except for the extra information given by the label <péjoratif>. Or the status of the entry for *giudeo* in the Italian Felice/Duro where the <figurative> label is accompanied by <spregiativo> (scornful, disdainful).

(3) *Fig. et péj.* N Vx. Personne âpre au gain, usurier. —Adj. Avare, âpre au gain. *Ce qu'il est juif!*

(4) *fig. spreg.* Persona avara, molto attaccata al denare e al quadagno; strozzino.

A set-theoretical analysis is sufficient to make clear why <figurative> is really inadequate and also dangerous for (3) and (4) and would be so for (1): if I is the set of impostors and J is the set of jews, then the canonical basis for empirical research should be the situation in Figure 4, which is the well-known format for the Theory of Generalized Quantification, one of the most successful semantic theories to date.

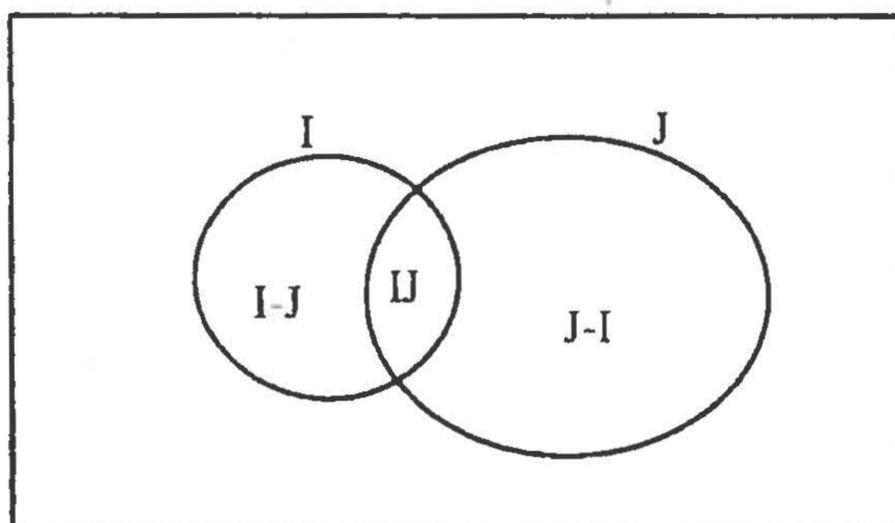


Figure 4

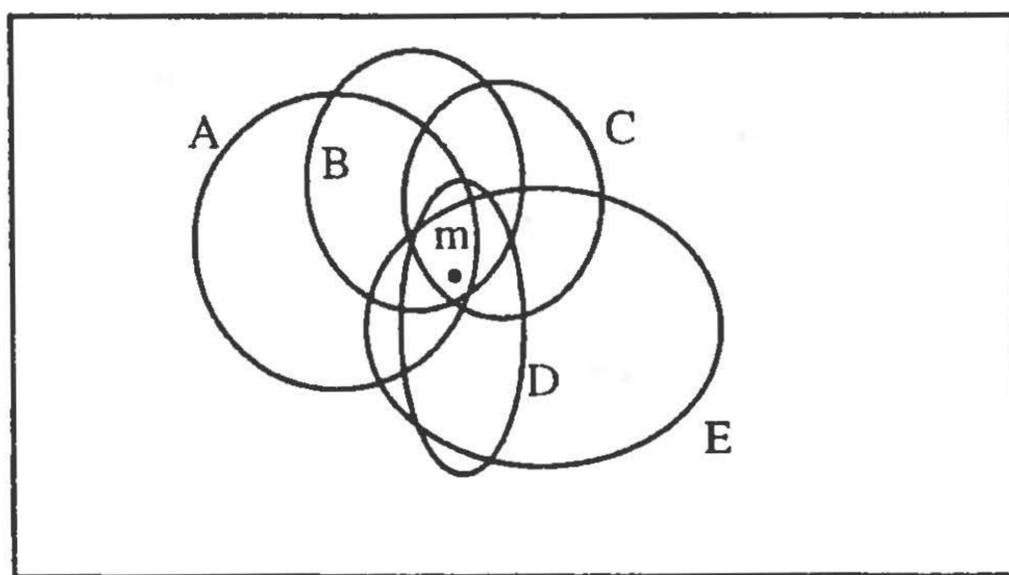
Here are five sets I, J, I-J (impostors who are not Jewish), J-I (Jews who are not impostors) and IJ (Jewish impostors). Theoretically, the sets I-J,

IJ, and J-I may be empty. Lexicographers making up definitions like (1), (3) and (4) before they put the label to it, are minimally required to check whether J-I is empty. But empirically it is a simple fact of life that no set in Figure 4 is empty. The writers of (1), (3) and (4) must have known this.

Figure 4 shows what happens if you empty J-I: you end up with  $J \subseteq I$ , that is, J being a subset of I. This quantificational discrepancy between reality and use should force a lexicographer into a label. Whatever it may be, never can and should it be <figurative>, <transferred> or <par analogie>, as defined in the entries of dictionaries. At this stage it is also important to see that labels like <péjoratif> in Petit Robert or <calificativo> in the Spanish María Moliner or <Beledigend> (Offensive) in Van Dale, or <spregiativo> in Garzanti, or <abwertend> in Brockhaus and Duden, or <offensive> in the OED suffer from basically the same failure to apply labels consistently and correctly, as I will show shortly. Again the basics of set theory will be a surprisingly good guide, it seems to me, to keep things tidy in this area.<sup>13</sup>

## 6. Sets of sets

Set theory provides the means to speak about sets of sets. Properties can be represented by (though not identified with) sets, so it has become standard in semantics to think of Mary in terms of the properties she has. In other words, we can treat Mary as the collection of all the sets to which Mary belongs.



*Figure 5*

Figure 5 gives you an idea: Mary is the dot m. She is an element of each of the circles. Mary is attractive, so she is a member of the set A of things that are attractive; she is a bachelor of Science, so she belongs to the set B

of bachelors of Science, she is a chess player, etc. Mary is unique due to the unique configuration of circles around her, which distinguishes her from other entities.

What about giving nouns a similar treatment? In Figure 6 we see a black spot but now it is a set rather than an individual.<sup>14</sup>

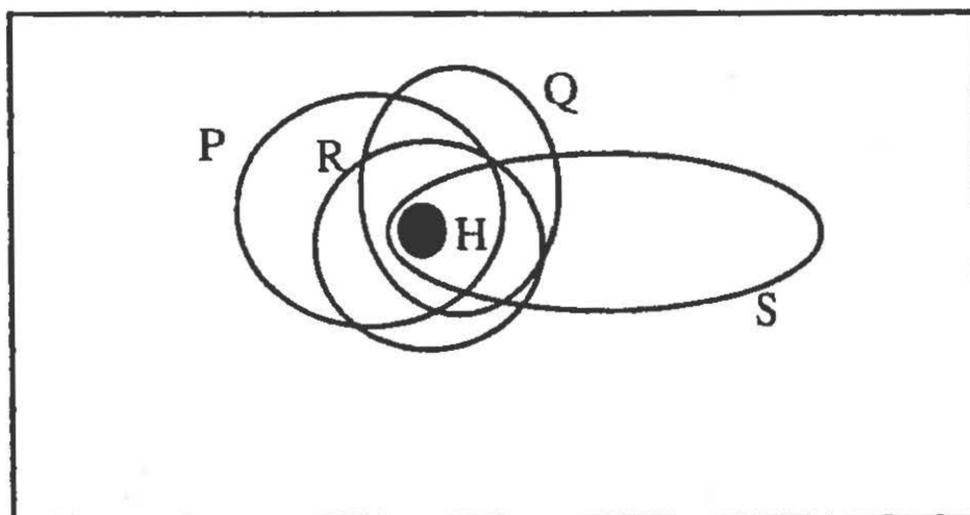


Figure 6

That is, H is made unique by its subset-relation to the sets P, Q, R, etc. It will be clear that Figure 6 gives exactly the same information as the C-rules of the model in Figure 3. If H is the set of horses and P is the set of mammals, then Figure 6 expresses that if x belongs to H, x also belongs to P. Less than a handful of circles will be sufficient, if the publisher allows that many.<sup>15</sup>

Suppose we have two nouns X and Y and we want to establish a figurative relationship between them. Then a reasonable way to proceed is to assume that they are both contained by the same circle, i.e. that they share a property which connects them in some way, as illustrated in Figure 7. This says (i) that X and Y are disjoint (an entity x cannot be member of both X and Y); and (ii) that both X and Y are subsets of Z.

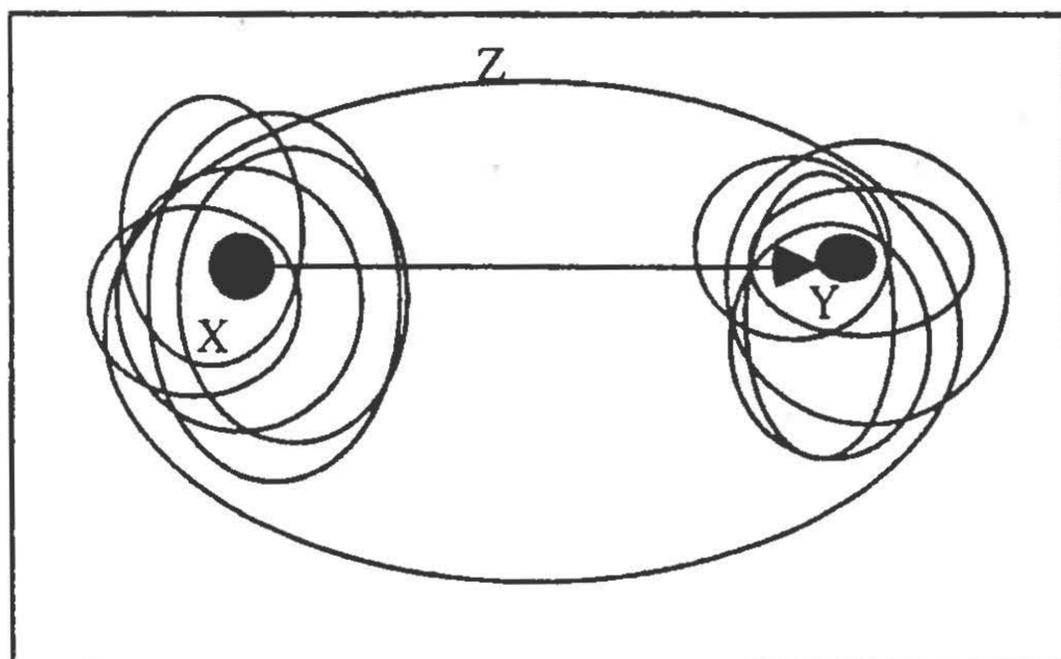


Figure 7

These two strict conditions on the relation between X and Y, given a sufficiently systematic use of the Z-relation between them give the label <figurative> a workable sense. It would become a technical term which must be explicated in the Preface of a dictionary and not in one of the entries, as customary. It determines the room for other labels coining different situations.

## 7. Restricting the label

Let us consider some cases. *Papillon* (butterfly) in the Grand Robert and Petit Robert is treated figuratively as: 'un esprit léger, volage', like *vlin-der* in Van Dale. This use can be supported on the basis of the two conditions of Figure 7.

X	Y	Z
papillon	personne volage	comportement inconstant
butterfly	capricious person	inconstant behaviour
chien	person you despise	inferior
horse	person	behaviour of a quadruped
exploser	se manifester	brusquement, violemment
boom (tree)	man	strong

In all these cases, the lexicographic format is (5):

(5) X <figurative> description of Y

The sets of butterflies and persons are disjoint, yet they are put into a superset Z and so they share a property on the basis of which transfer of the name X to the N of the concept Y can take place. This holds for all other cases.<sup>16</sup>

Let us now apply this to (1), (3) and (4). The simple question is: do they fit in this scheme? No, they do not.

X	Y	Z
jew	impostor	?
jew	?	impostor

In the first row we know that the intersection XY is not empty, so here the condition of disjointness forbids the use of the label. But apart from this, it is logically impossible to add a property that anti-semitic people would fill in, say inferior. The label <figurative> would immediately lead to the paradoxical situation that for the expression of this anti-semitism it is required that jews are not impostors. In the second case, there is no Y available because if it satisfies the first condition the entry would get a totally different meaning as I shall point out shortly. So, the use of schemata like Figure 7 shows that the <figurative>-label in (3) is wrong and misleading.<sup>17</sup>

Why did lexicographers using these labels not see these elementary aspects of quantificational theory? Because of the mirror-argument, I am afraid. They felt safe in reporting things from the cruel big world and forgot to think orderly. The mirror does not reflect labels: labels are not mirrored, they are produced and remain the tools of the lexicographers. So, they are quite telling.<sup>18</sup> But don't we use language non-literally? Yes, indeed we do, as long as we think we apply language literally and non-literal is the complement of literal. But the structure of the non-literal domain is much too complex and diverse to simply equate it with figurative as so many dictionaries do.<sup>19</sup>

At this point, the pejorative labels in (3) and (4), and labels like <spregiativo> for *guideo* in Garzanti and Felice/Duro, <abwertend>-label for *Jesuit* and *Bauer* in Brockhaus, <offensive> in OED, and the more neutral <calificativo> for *judio* (jew) and *perro* (dog, chien) in María Moliner should be implicated in the analysis. These labels blur a distinction between what one could call left-offensive and right-offensive. The two configurations in (6) make this clear. <Offensive> represents all the labels just mentioned.



Entries like (1), (3) and (4) are left-offensive because impostors (Y) are not offended by calling them Jew (X): it is the X's that are offended by calling them Y. Maybe impostors feel offended when they are called *Jew*, but this is not what the entry purports to say. The cheater or usurer in Y is no more offended by the use of the X-word *Jew* than by the use of the Y-words *impostor* or *cheater*. The dog-entries are right-offensive: it is

members of the set *Y* that are offended by the name *X*. Of course, dogs cannot really be offended, but we have the word *boer* (farmer, Bauer, boor) for describing persons with a sort of “ungebildetes, ungehobeltes Benehmen” as our German friends say. This is right-offensive: a person behaving badly is socially punished by calling him a boor. Farmers may be offended by this use of the word, but yet there is a crucial difference: the name *farmer* is used to offend a member of *Y*, who is not a member of *X*, which is to say that it is used optimally by the condition of disjointness (i). In general, the difference between left- and right-offensive can be tied up with the set-theoretical configurations just discussed.

What would I do in these cases? Well, taking Von Neurath's boat-metaphor seriously, I would first abolish the bad habit of not defining labels outside the entries. I am aware that readers skip the foreword, but yet it would lead to a considerable improvement. In the case of (1), (3) and (4), the label <stereotype> would do, if properly defined in terms of Figure 4.<sup>20</sup> I would have a look at American dictionaries, which seem to be more relaxed or careful in describing the discriminatory use of words than the Europeans, and I would take as a guide line: what sort of information need foreigners who speak a language well enough so as to be able to use a monolingual dictionary.

As to the labels <figurative>, <transferrable>, <par analogie>,— apart from the remarks I will make shortly in view of what the L-model says about polysemy— it seems to me that these labels should be either eliminated or be properly defined in terms of configurations like Figure 7 or Figure 1; that is, in terms of sets and relations between them so as to keep the dictionaries tidy.<sup>21</sup> These seem too simple truths to be told in an address like this, but looking at dictionaries you can see that most of them have not yet made a beginning with cleaning up. Set theory shows its force immediately: if something doesn't fit, you either have to adapt the conditions or it simply does not belong to the concept you are using. It's quite effective.

## 8. Some extensions of the model

In this section, the L-model will be explored from the point of view of ongoing discussions in the literature. Being so close to the lexicographic practice, it might be checked on how it treats polysemy, which is so closely related to the use of figurative, because many senses arise by the simple fact that the range of a certain meaning is extended or specialized.

Recall Figure 1 where a function splits domain into entities which are mapped to 1 and to 0. If the name of *horse* is applied to non-animals, the domain of the function is extended to map a certain set of non-horses to 1. Our Figure 7 relating X and Y by Z is in fact a description of applying two conditions on this function.

Stereotypical meaning can also be dealt with in this way by considering conditions giving away specific ways of quantification. As I pointed out, the reduction of J-I in Figure 4 to the empty set leads to stereotyping. As to the prototypical HORSE, I think one needs to be skeptical about prototypicality as a lexicographic notion. For me, the prototypical horse is the sort of horse used by the Amsterdam police. In the L-model it would be sufficient to allow a sort of indexed rule putting the information in top of C either by having a biconditional rule

$$\text{HORSE}(x) \Leftrightarrow \text{QUADRUPED DRIVEN BY AMPOL}(x)$$

or by having a leftright arrow. It would be necessary to relate this sort of information to the rules that determine the cognitive organization of the “regular” knowledge. Whatever the extension may look like, it should help to explain why my prototypical bird in Holland—which is a magpie because it dominates the Amsterdam gardens—differs from the prototypical bird in France, which is a cuckoo in October and a buzzard during the summer. Frankly, I think that lexicography shouldn't give a very central position to prototypicality, their main job being to find non-prototypical “hard” information.

On my way to saying some general things about so-called cognitive grammar and model theory, I will add some more features to the L-model in view of recent discussions in the literature, and also because one could say ‘Why do linguists always take easy cases like horses and bachelors’? So, let me briefly say something about part-whole relations that seem to be in conflict with the subset-relation determining the L-model.

Following the literature, let us consider carburetors and chapters as mereoparts of the structure they belong to. In Dutch, we would translate the predicate MEREOPART as ‘onderdeel’, which makes it possible to distinguish it from PART OF, which means ‘deel van’.<sup>22</sup> It would lead to rules like the following:

$$\begin{aligned} \text{CARBURETOR}(x,y) &\Rightarrow \text{MEREOPART\_OF}(x,y) \ \& \ \text{ENGINE}(y) \\ \text{CHAPTER}(x,y) &\Rightarrow \text{MEREOPART\_OF}(x,y) \ \& \ \text{PIECE\_OF\_WRITING}(y) \end{aligned}$$

Recall that the information expressed by the rule:

$$\text{MEREOPART\_OF}(x,y) \Rightarrow \text{PART}(x,y) \ \& \ x \notin y$$

is connected with the word form *onderdeel*. One can easily see that the subset relation has been maintained:<sup>23</sup>

$$\text{CHAPTER}(x,y) \subseteq \{ \langle x,y \rangle \mid \text{MEREOPART\_OF}(x,y) \ \& \ \text{PIECE\_OF\_WRITING}(y) \}$$

and that the different sorts of algebraic structure (lattices, Boolean algebras) are expressed by concepts which receive an explanation in **L** itself.<sup>24</sup> But there is an important difference: model theory relates all these concepts to entities outside the language itself: the domain of interpretation which, dependent on the philosophical stance, is either realistically or mentally.<sup>25</sup>

Note also that the rule defining the concept CHAPTER states that not every piece of writing has chapters but may have them, Likewise, the following rules state that a chapter is not an element of a book and so the whole system allows that there be books without chapters.

$$\text{BOOK}(x) \Rightarrow \text{PIECE\_OF\_WRITING}(x)$$

$$\text{BOOK}(x) \Rightarrow \text{MADE\_BY}(x, y) \ \& \ \text{AUTHOR}(y)$$

$$\text{BOOK}(x) \Rightarrow \text{STRUCTURED\_BY}(x,y) \ \& \ \text{CHAPTER}(y)$$

I could not skip this part of the present exploration of the **L**-model in view of the fact that from the computational side a very interesting proposal is made by Pustejowsky (1991;1992).<sup>26</sup> To unburden the information associated with verbs he proposes to assign a sort of standard format for nouns, which he calls Qualia Structur. This proposal has received considerable attention in the literature. The Qualia structure of *book* has (roughly) the following form:<sup>27</sup>

$$\text{Constitutive role}(x) = \text{INFORMATION}(x)$$

$$\text{Formal role}(x) = \text{PIECE OF WRITING}(x)$$

$$\text{Telic role}(y) = \text{READ}(y,x) \ \& \ \text{RECEIVE}(x,\text{information})$$

$$\text{Agentive}(x) = \text{ARTIFACT}(x), \text{WRITE}(z,x)$$

The important thing here is that Pustejowsky wants a sort of systematicity in the organization of noun information by covering important aspects of

the meaning. In this way he can deal with the difference between sentences like *John bought a book* and *John began a book*. The verb *buy* can be characterized as taking an object of type *e*. *Buy* takes an *e* and yields a set *et* of those who bought a book. Now, the problem is that *begin* cannot very well be *e(et)* because John did not begin an object (type *e*), he began to write or read a book. We need some assimilation to accommodate a temporal interpretation: John began to write a book or to read a book. According to Pustejovsky the Qualia structure explains why this is so: the temporal structure needed is part of the Qualia Structure.<sup>28</sup>

There is a lot more to say about this issue than I can do here, but I will restrict myself to saying that the Qualia-information is available in *L*. So, the issue is whether Constitutive, Formal, Telic and Agentive are fruitful meta-predicates which can serve as guidelines for entries. In the *L*-model it is left open whether all nouns should be moulded in this way. It seems to me that Qualia structure is either a (rather arbitrary, but possibly motivated) restriction to four structural patterns in the *C*-conditions of a concept or a sort of prototypical meta-structure in the sense that it claims in that certain rules are favoured and stored in top of an information cluster. A similar sort of view could be developed with respect to the question of whether there are primitive concepts or not: they simply show up in *L* if they are there on the basis of the governing subset-relation.<sup>29</sup> This relates to the last point: lexicographers are interested in the *differentiae specificae*: which one should they choose?. My answer to this is that many lexical items belong to a structured domain of knowledge, as in the chess example. It should be the knowledge domain which determines which *differentiae* are relevant. Here the five *C*'s fully apply.

Rounding off my first Message, I would like to observe that the *L*-model is just a means for making the point that you cannot evade the mathematization entering our fields and that you better participate actively in it. The use of labels, the structure of the definitions, but also polysemy, stereotypicality, part-whole relations, etc. can be captured best by using well-established algebraic tools. This will provide the solid ground for dictionaries of the new era so that they meet the five *C*'s in a sensible way.

## 9. Some final remarks

At the close of this talk, I would like to make some remarks about the peculiar situation that I have been discussing a cognitive model of the lexi-

con while using sets and algebraic structures, whereas leading cognitive semanticists consider the use of model theory and formal tools as coming from the hell of empiricism or other devilish places. Let me say a couple of things about this.

Jackendoff (1983) considered truth conditional semantics in the model-theoretic framework as belonging to an empiricist enterprise. Both Carlson (1985) and Verkuyl (1985) pointed out that this is a completely wrong interpretation of model theory, because set theory and the algebraic structures it can deal with are neutral as to any linguistically relevant sort of philosophy, certainly at the elementary level at which it is being used in linguistics. Jackendoff himself modified his earlier position in *Semantic Structures*, by saying that he saw the point but he prefers to use his own formalism. This is, of course, his right, but the conclusion must be as in Zwarts and Verkuyl (1994) that Jackendoff's Conceptual Semantics indeed belongs to model theory. And this means that Jackendoff's fruitful insights can be formalized. Absolutely similar translations would be possible for any informal idea of linguists calling themselves cognitive grammarians, as soon as it is articulated such that it can be understood.<sup>30</sup>

Truth-conditional semantics is made suspect by many linguists calling themselves generative or cognitive grammarians or whatever other school of grammarians. This is a very unfortunate situation and gives away a harmful bias, suggesting that model theory is just a philosophical stance or a school. This makes it possible for people to discard it as something contaminated, which one can put aside simply because one has a different philosophy. This sounds too postmodern to be taken seriously. With respect to the name Cognitive Grammar it would be wise to see whether certain sociologically relevant patterns of American university life give birth to a new ideology or to a genuinely new body of linguistic insights, before Europeans commit themselves to it. If negative discriminatory terms require labels in a dictionary, then their "duals" should be labelled as well: without special labels they are simply misleading (*Cognitive* with capital C is said to mean 'major breakthrough', 'new paradigm', etc). We need here our Figure 3 in order to establish that if *cognitive X* means that X is based on putting the cognitive organization of human beings as a central research goal, then it cannot possibly mean that generative grammar is being excluded from that area. After all, the rise of cognitive psychology has very much to do with the fact that generative grammar focussed on the language faculty as a cognitive structure. Grammarians

fostering a simple anti-model theory bias expelling it from the area of cognition, do not seem to understand the real issue: the only sensible and interesting opposition at the moment in the area in which we are acting is proof theory (that is, theory formation by syntax; basically what some philosophers and logicians, among which Chomsky do) vs. model theory (that is, theory formation by interpretation; basically what is done by other philosophers and logicians, for example in the Montague tradition). Lexicography seems to me to belong to the second way of life.

It is important to say this here and now, because as I showed earlier by a quote, lexicographers—at least in Holland but also elsewhere—after their rightfully unhappy experiences with generative grammar which failed to provide proper tools, tend to be now lured into the nets of cognitive grammarians under the false impression that these have a sort of secret key to the treasures of contextuality, pragmatic factors and world knowledge. I do not suggest that cognitive grammarians are wrong in what they are doing: many fruitful ideas may arise. What I say is that some of their proponents are wrong in their opinion about the rest of the world, specifically about the developments in mathematical logic which has turned to natural language as one of its legitimate domains of research.<sup>31</sup> As a linguist operating in this area I can report that it is a relief that from that score of life linguists (generative, cognitive, functional, etc. etc.) can learn that it is counterproductive to produce ideologies rather than insights. In spite of the many differences in opinion, there is a common steadily growing body of insights which is used by the whole community, as usual in mathematics. If this sense of progress is one of the fruits of the mathematization which is now already firmly rooted in our region, I hope that the tools I described will be used indeed in lexicography. But I am aware that I have crossed the border of preaching and so in spite of the natural context for that sort of speech act here at this university I will stop and thank you for your attention.

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<sup>1</sup> The present Big Van Dale has nearly 4000 pages. It is the top of a range between about 2000 and 4000 pages. Petit Robert, Duden, Felice/Duro, Garzanti are at the bottom, Shorter OED and Maria Moliner are somewhere in the middle. This is just a rough indication, because focussing on definitions it is misleading to measure the size of a dictionary by the number of pages, or even in terms of characters (including empty space). The definitions of the OED appear sometimes literally in the Shorter OED.

<sup>2</sup> In this particular case, this wrong strategy led also to misleading information. In the Petit Robert mathematicians are quoted for the illustration of the use of mathematical terms.

<sup>3</sup> Cf. Martin (1994) for an attempt to develop a strategy in terms of conceptual frames.

<sup>4</sup> The same goes for problems of argument structure, polysemy, primitives, etc. Recent collections of linguistic work on the lexicon demonstrate the point I am discussing here quite painfully: they hardly ever get to pegging out lines which lexicographers are forced to follow (Geiger and Rudzka-Ostyn 1993; Lehrer and Kittay 1992; Pustejovsky 1993). Not that these works are unimportant, they *are* within the linguistic circles which focus on the role of the lexicon. But linguists meet there fellow linguists, cognitive psychologists and philosophers rather than lexicographers. It is as if lexically oriented linguists, psychologists and philosophers keep things for themselves, so to say: they discuss the cognitive organization of the mental lexicon, or they theorize about lexical fields or frames, or about the structuring of color names, and hardly ever concrete lexicographic problems come in view (This applies even to Fillmore and Atkins 1992 by its open end on polysemy, as they admit themselves). So, one may state that there is no natural tie between linguistics and lexicography in terms of discovering and applying principles making dictionaries up to date. In Holland, there are lexicographers who are deeply convinced that they structurally need no help from their linguistic foes. They consider the making of dictionaries as a basically literary enterprise, revealing the niceties of language by quoting from writers and poets. So, on both sides there are some communicative problems, it seems.

<sup>5</sup> There are differences with the technical notions of consistency, completeness, etc. but still there is a considerable degree of correspondence. Let us say that the notions I discuss in this section are substantially "fed" by their logical counterparts.

<sup>6</sup> I make the proviso 'Most of the' in view of the fact that Figure 1 is restricted to properties (sets) which are in the interpretation of one-place predicates. For two-place verbs and nouns (type eet) the picture is more complicated. The function requires now two individuals, so one way of doing this is to think of a two-place verb *V* as splitting a domain into a set of pairs whose elements stand in the *V*-relation (mapping this set to 1) and a set of pairs not standing in this relation. Etc. This complication of Figure 1 does not affect the point made here.

<sup>7</sup> The rules are written informally and sloppily for the purpose of expressing the main idea. The right-hand side of the second rule should be read as a one-place predicate over *x*, appealing to standard quantificational techniques. Cf. also section 8 for some remarks about the *n*-place nature of concepts.

<sup>8</sup> I have in mind here the well-known problems in the Katz/Fodor semantics of the sixties, which is related to the sort of decomposition rejected in Kripke (1973). Cf. also Fillmore and Atkins (1992: 101) and the Cobuild approach. Also Cruse (1986;1992: 290) for a similar view. In Figure 3, the lexicon is considered a theory of the world as we conceive it via *C*. (cf. Paprotté 1993:191; Dahlgren 1988). This facilitates our view on the relation between lexical knowledge and world knowledge considerably (cf. Moerdijk 1993). Note also that the need for fuzzy sets was invoked by problems related to characterizing nouns in terms of sufficient and necessary conditions. The well-known penguin-problem (they are birds but they cannot fly) also receives a rather natural solution in the *L*-model: penguins are specified as birds that cannot fly, birds as animals with wings, and having sufficiently large and strong wings can be seen as a condition on flying. So, it is not strictly necessary to define birds as flying animals.

<sup>9</sup> This seems also to solve a lot of problems connected with approaches as discussed in Barsalou (1992: 44ff.). A second advantage may be that the L-model allows for "long distance" updating. If something changes in the definition of ANIMAL, this will have consequences for the meaning of the word *horse*. It also helps to explain why we can use so many words in such a short time (cf. Paprotté 184ff.). In using the word *horse* one may even restrict its meaning (in a given context) to one or two rules directly available. I come back to this point below.

<sup>10</sup> ...dat de woordbetekenis het lexicaal concept is dat met de woordvorm te verbinden is. Daarbinnen vervalt het onderscheid tussen linguïstische en encyclopedische kennisgegevens. Een concept staat echter nooit op zichzelf maar is met andere concepten in een conceptuele structuur verenigd (Moerdijk 1993:25).

<sup>11</sup> As many of the contributors in Lehrer and Kittay (eds.) and in Geiger and Rudzka-Ostyn (eds.).

<sup>12</sup> Verkuyl (1993b: 322-327). Let me put aside the question of whether <figurative> is a lexical notion indeed and in particular, a useful lexicographic label. In our blueprint we skipped it, just like Cobuild has dropped it to its benefit, because the figurative use of words, if not a matter of regular forms of polysemy, seems to be a matter of sentential interpretation. Here I will accept it as a label, which means that I shall try to save it by putting precisely formulated restrictions on its use. We can then see how far we get and what sets have to do with it.

<sup>13</sup> In Verkuyl (1993b), it was argued that anti-semitism in the Jew-entries in Van Dale is located in presuppositions tied up with the descriptions rather than in the descriptions themselves. This makes it possible to beat the usual mirror argument practiced by so many lexicographers who say that you should describe the good things (which they somehow always forget to do) and the bad things (which they feel forced to do). But that is another story which I will not tell here again. Here I will just focus on the need for a precisely defined basis for the use of labels, in this case <figurative>, if lexicographers decide to use them. It might also help Petit Robert to get rid of the <Fig.> in (k). And perhaps of the whole entry in this form, as I will point out below.

<sup>14</sup> Obviously there will be differences between the treatment of proper names and nouns. E.g. Mary will have many more circles around her. But the technique of taking nouns as the proper name for a category is comparable.

<sup>15</sup> Theoretically, this will lead to the question about how to account for the fact that there are white, black and all sort of coloured horses, that there are wild and domestic horses. The answer is that the fact that there are many different colours among horses follows from some other part of the knowledge system, of the form, say,  $\text{Object}(x) \Rightarrow \text{Have\_Colour}(x)$ . Lexicographers have the advantage of not being forced into a full-fledged meaning description: they have only to include H in those sets so as to make H sufficiently unique.

<sup>16</sup> It amounts to: if  $y \in Y \cap Z$  and if  $x \in X \cap Z$ , then  $x = y$ , where  $=$  allows you to say that  $y \in X \cap Z$ . There is some sort of identity involved: *Ce garçon est vraiment un papillon* (This boy is really a butterfly).

<sup>17</sup> In newest edition of Van Dale the label <oneig.> has been replaced by <offensive>, but see my remarks on that below. Of course, one could define <figurative> in such a way as to capture *juif*, but this means that the other cases which meet the conditions on Figure 7 are no longer covered by it.

<sup>18</sup> In this postmodern era, I am often struck by the paradoxical situation that people seem to have forgotten that the ones who in the thirties of this century developed model theory as a way to obtain clarity and rational behaviour by using truth conditions as a guideline, in general did not belong to the persecutors but rather to the persecuted. And that among those who relativize truth as a criterion for civilized behaviour there are people sympathetic with ideas and people associated with the persecutors. See Coffa (1991) for a very good survey of the issues involved. It convinced me deeply of the necessity for the social and human sciences to have a far more modest role in the discussion about the relativization of truth than has been the case in the postmodern and deconstructivist seventies and eighties.

<sup>19</sup> There is a huge class of cases in which both conditions for the use of <figurativity> in Figure 7 are met, whereas it would be rather odd to list the chess horses and the four-legged athletic instrument as figurative horses, because they represent real horses, as in Felice/Duro for *cavallo*, for example. It does not make sense on the penalty of having to use the word *horse* figuratively if we talk about a picture of a horse. It would make talking about anything we see on TV completely figurative. Dictionaries are quite inconsistent indeed in this respect. Take the definition in OED of *figurative* in one of its senses 'Pertaining to, or of the nature of, pictorial or plastic representation'. If this is one of the senses of *figurative*, <figurative> is useless as a label, because in many cases of pictorial representations the OED does not use it. Moreover, it would block any systematic treatment of polysemy. Z in Figure 7 as 'Having a similar form' raises a lot of problems. For example, Van Dale, Petit Robert, Académie, etc. give <figurative> for *distance* in the case of a socially determined ranking. Petit Robert gives a separate sense for its temporal sense (Ecart entre deux moments), thus taking the spatial sense as literal, but why? And why does the Académie use <Par analogie> (by analogy) and not <Figuratively> for the temporal sense? A sufficiently abstract definition of distance may take the notion of interval used in the number systems as basic. If this sense would be taken as primary, it would follow that the spatial, the temporal and the social sense in which ranking is involved are just senses modelled after the mathematical meaning of *distance*. As said earlier, in our Blueprint we did not use <figurative> as a label.

<sup>20</sup> In Verkuyl (1993b) I proposed in fact a practical solution for the many discriminatory entries in Van Dale with the prefix *joden* -(jew-). It turns out that if a prefix of the form *X-en-* pertains to a group or set X, it tends to get a negative meaning. Thus, *een Amerikanenvrouw* (American-woman) whatever it may mean— it means something like a woman having something to do with Americans— gets quite a negative connotation by some interesting morphological rule having this effect. This doesn't hold for the adjective *Amerikaans* (American). Cf. *Turkenvrouw* (Turk-woman) vs. *Turkse vrouw* (Turkish woman). So, it is possible to have an entry with *joden-* and *Turken-* in which this negative connotation is explained. The result would be that dozens of dubious entries with *joden-* can be dropped (there are not so many with *Turken-*). See also Hauptfleisch 1993.

<sup>21</sup> This can be demonstrated by the following example. Can we use *cheval de Troie* as figuratively as a ruse of war, as in Académie? We could, but the only proper way for doing this is taking *cheval de Troie* (X) as the name of a concrete noun transferred to an abstract noun Y. In this case, the condition (i) of disjointness is clearly met, so one faces the problem of whether sets of concrete and abstract things may be both subsets of a set Z. At that point one may decide about whether a separate class of cases must be distinguished.

<sup>22</sup> Cf. Chaffin and Herrmann (1988), Chaffin (1992). The discussion about mereoparts and parts would also quickly solve some of the problems discussed in Barsalou (1992) and Iris, Litowitz and Evens (1988). A lot of these problems have been solved in the Theory of Generalized Quantification, in which detailed studies of different sorts of algebraic structures have taken place.

<sup>23</sup> In the rules given here CARBURETOR and CHAPTER are treated as two-place predicates. One could also treat them as genuine 1-place predicates, e.g. CHAPTER(x)  $\subseteq$  {x|MEREOPART\_OF(x,y) & PIECE\_OF\_WRITING(y)}, or as 1-place predicates created by lambda-abstraction so that retain their 2-place structure (see e.g. Gamut 1992).

<sup>24</sup> Cf. Cruse 1986, Iris, Litowitz and Evens 1988; Chaffin and Herrmann 1988. To keep things readable, I have dropped the difference between e.g. CHAPTER and its interpretation I(CHAPTER), where CHAPTER is the name of the concept and I(CHAPTER) its denotation.

<sup>25</sup> It is not impossible to bring Mel'cuk's functions home here: they have all their own name in the N-component of L and they have their own conceptual specification (functions are also subsets). Cf. for example Mel'cuk (1982;1988). Lexical functions determine collocations which are outside the scope of the present paper (cf. Heylen (1994) for a review on this part of Mel'cuk's work).

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<sup>26</sup> I will not go into predicates expressing modalities among which probabilities here (cf. Dahlgren 1988). The L-model should of course be made more precise in terms of a quantificational structure, as standard in model theory.

<sup>27</sup> Pustejovsky (1991;1993) gives the Qualia structure of *novel*. It is striking to see that it is rather difficult to assign a Qualia structure to *book*. So, I made the best out of it, but it strengthens my conviction that the four aspects of Noun structure are rather forced. It seems to me that one can better provide for the information without casting it into four roles.

<sup>28</sup> Jackendoff (1983;1990) appeals to what he calls rules of construal, Pustejovsky (1991;1993) characterizes this problem in terms of the notion of coercion and by doing this, he uses the type theory underlying the operations just exemplified. Ross (1992) uses the term *contagion* in a curious variant of the Zwicky-treatment of semantics.

<sup>29</sup> There is no objection for Q in  $P(x,y) \Rightarrow Q(x,y)$  to be a Mel'cukian function. The same applies mutatis mutandis to the concept of semantic fields. A semantic field Q can be construed on the basis of "collecting" the concepts  $P_1, \dots, P_n$  in  $P_1(x) \Rightarrow Q(x), P_2(x) \Rightarrow Q(x), \dots, P_n(x) \Rightarrow Q(x)$  (cf. Grady 1992; Lehrer 1992).

<sup>30</sup> The currently very dominant Discourse Representation Theory has been developed by the model-theoretician Hans Kamp. It has incorporated a level of mental representation, say mental representation boxes, which provide partial information structures set apart from the real world (cf. Kamp and Reyle 1993).

<sup>31</sup> E.g. Geeraerts (1993), Taylor (1993), but also Lehrer and Lehrer (1992)

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