Frame-based Lexicons and the Making of Dictionaries

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Abstract
In this paper it is shown how frame-based lexicons can lead to better dictionaries. Advanced Learner's Dictionaries are taken as a case-in-point, starting from the definition that 'an advanced learner's dictionary is a dictionary meant for L2-users with the aim to give them a thorough command in L2 of the most important linguistic functions (needs), viz. to understand, to speak, to write and to read in the FL.' Furthermore, the following assumptions apply:
• in order to further better understanding, learner's dictionaries should make use of the most adequate definitions, including other than verbal ones;
• in order to provide for better production, learner's dictionaries should provide the learner with the most typical collocations;
• in order to help better retention, learner's dictionaries should not (only) present lexemes in alphabetical order, but (also) order them thematically;
• in order to further better communication, learner's dictionaries should not be coupled loose from language didactics/ language learning methods.

1 Introduction

This paper consists of four parts. In the first two sections basic notions such as frames and lexicons are presented and explained. The next section deals with the relationship between these basic notions. The last section demonstrates how learner's dictionaries can profit from frame-based lexicons.

2 Frames

There exist at least two 'schools' in frame linguistics, the one more in the Fillmorian (Fillmore (1977)), the other more in the Minskyan (Minsky (1975)) tradition.[1] At first, Fillmore's treatment of frames was strictly linguistic: further elaborating upon his case grammar, he took the syntactic-semantic description of lexical items such as *buy* and *sell* as a starting

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[1] Frames are not only used in Linguistics and Cognitive Studies but in Economics as well. A good example is *Choices, Values and Frames*, ed. by Daniel Kahneman and Amos Tversky, Cambridge/ New York: CUP, 2000.

point and examined how these items could be associated with prototypical instances of scenes (e.g. the trade/ business scene).

SELL	
ISA	commercial transaction
SELLER	who sells?
GOODS	what is sold?
BUYER	to whom is sold?
CONDITION	for what is sold?

Table 1. Example of a 'Fillmorian' frame (based on: Fillmore/Johnson/Petruck (2003)).

The AI approach, in a sense, starts from the opposite direction: taking knowledge about 'situations' ('scenes' in Fillmore's terminology) as its point of departure, it uses frames as

'datastructure[s], for representing a stereotypical situation...[a frame] is a collection of questions to be asked about a hypothetical situation. It can be viewed as an organized matrix of slots for given states of affairs.' (Minsky (1977: 355))

Later on, Fillmore will also take up a broader, more knowledge-oriented point of view. Witness his 'risk' paper (Fillmore & Atkins 1992) and his later work on FrameNet. Here the central idea is

'that word meanings must be described in relation to semantic frames – schematic representations of the conceptual structures and patterns of beliefs, practices, institutions, images etc. that provide a foundation for meaningful interaction in a given speech community. FrameNet identifies and describes semantic frames, and analyzes the meanings of words by directly appealing to the frames that underlie their meanings and studying the syntactic properties of words by asking how their semantic properties are given syntactic form' (Fillmore/Johnson/Petruck (2003: 235)).

In the Minskyan (AI) sense, frames, as stated, are data structures to represent stereotyped knowledge within a *slot-filler* format. From this point-of-view, a *frame* is a set of general conceptual categories (*slots*) followed by specifications (*fillers*). As such, AI views frames as structures containing stereotyped, implicit background knowledge which is necessary in order to understand concepts and (word) meanings. To make the notion more clear an example of an AI-frame follows in table 2.

MUSICAL INSTRUMENT

SLOT	FILLER
isa	wind/ percussion/ stringed/ plucked/ keyboard/ ... instrument
function	special function other than musical
material	
size	as compared to other members of the subtype
form	
parts	

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           material          ·      .
           size
           form
accessories
           material
           size
           form
sound                              typical sound produced
user                               typical user
manner of playing
position of player
position of instrument             vis-à-vis player
mechanism                          working of instrument
origin
typical genre                      typical musical genre the instrument is used in
similarity                         similar to
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Table 2. Example of a 'Minskyan' frame (based on: Martin (2003:14)).

Although there is no room here to further elaborate upon the concept of AI-frames (in this respect, see Martin (1994), Martin (2001), Martin (2003) and Martin (to appear)), yet a couple of general remarks seem to be appropriate for a better understanding.

First of all, frames are type-bound: for any particular token (e.g. GUITAR) there exists a class, category or type to which it belongs (e.g. MUSICAL INSTRUMENT). The slots of the frames are bound to the type.

Secondly, as the fillers can only be filled out in the case of a concrete token, they are left unspecified here. What one finds in table 2, therefore, are a kind of comments (see e.g. under *size*), clues on how to interpret the slot (see e.g. under *similarity*), suggestions/ values for defaults (see e.g. the slot *function*, where it is suggested that the default value for the item in question is 'musical') and pick lists (see the *isa* slot). Actually, the values of the fillers in the case of a concrete token (a lexical item) are/ should be conceptual domains, concept types (which call for other frames), concepts (which can be paraphrased in words) or lexical items.

Thirdly, although, in a way one could argue that the features of, for instance, a 'structuralistic' word field table for musical instruments – partially – correspond to the slots of the frame 'musical instrument', yet the fillers in table 2 are no longer restricted to yes/no-values (+/–), but are more related to the *differentiae specificae* of definitions. This way the semantic frame, AI style, is a semantic representation of the 'meaning' of a word, i.e. the knowledge needed to understand its meaning.

Prima facie this knowledge seems to be rather 'encyclopedic', more 'world' than language-oriented, yet this is in line with the cognitive development in linguistics where the boundaries between linguistic and extra-linguistic knowledge have become more and more vague. Moreover, what both AI- and FrameNet-frames, although they may differ in orientation and in depth, have in common, and differentiates them from a word field approach, is

that they do not only describe the meaning of words via frame elements or slots, but that they also link words with the combinations these items participate in.

As a final remark, it has to be stated that the list of slots is not a mere listing of unrelated items. Just as the slots relate the token item with its fillers, so the slots themselves are interrelated, for instance the *isa* slot with the *material* and *parts* slot.

In the following section we will try to make clear what kind of impact frames have upon the notion of the lexicon.

3 Lexicons

In an article that served as an introduction to the 1990 VU (= Free University) yearbook *Corpusgebaseerde Woordanalyse* (Corpus-based Word Analysis), Baayen & Booij (further B&B) (1990) make a distinction between *four lexicons*. In what follows, we will paraphrase these interpretations and briefly comment upon them (see also Martin (1992: 128)).

As a first interpretation, B&B mention the most traditional and, from a linguistic point of view, least interesting interpretation, viz. that of the lexicon as 'a set of existing words such as in a dictionary'. It goes without saying that this is, among others, a rather static and problematic (when does a word exist?) interpretation of a dynamic phenomenon.

The second and third interpretation, lexicon 2 and lexicon 3 in B&B's article, are more linguistically motivated approaches. In a first, the so-called Bloomfieldian, approach the lexicon is an appendix of the grammar, a list of basic irregularities. In other words, in this view there is no room in the lexicon for, for instance, regular compounds or derivations. The lexicon is considered as 'a set of existing idiosyncratic lexical items (morphemes and morpheme combinations)'. Although the lexicon gets a place in the linguistic system, it still remains peripheral (an appendix) and static (dealing with 'existing' words).

In the third interpretation – lexicon 3 – the lexicon, with the advent of generative morphology, definitively looses its static character and becomes 'a set of existing idiosyncratic lexical items (morphemes and morpheme combinations) together with a set of morphological rules (to form possible non-idiosyncratic morpheme combinations)'.

Finally, B&B refer to the so-called 'mental lexicon' (lexicon 4), which they distinguish from the 'linguistic lexicon' (lexicons 2 and 3), focusing much more strongly than the former interpretations did on linguistic performance (instead of competence) and usage (both active [production] and passive [perception]).

It is this notion of the lexicon as a dynamic component of a linguistic system in use that we will here adhere to. In other words, 'the lexicon as an organised lexical knowledge bank needed by users so to be able to understand and produce language' (Martin 1992: 128).

4 Frame-based lexicons

In the above definition of lexicon the attribute *organised* is of prime importance. Just as a grammar is an organised set of combinatory rules, so too the lexicon is, among other things, an organised set of lexical meaning relations. In a frame-based lexicon the entries of the lexicon will be pairs of LU's (lexical/ semantic units),and conceptual frames, the latter expressing semantic relations. This does not exclude other information from being present in the en-

tries such as 'formal' data (orthography, phonetics, morphology) and syntactical data, but it gives a prominent place to (relational) conceptual semantics.

In this respect, frames are more than just semantic representation schemata. In fact, the slots of the frames function as links between the nodes (the item under description and its fillers) and in this way model the lexicon as a large semantic network, a large sematic web or superframe consisting of many subframes (types) combined with each other. This network has *explicit* links, such as the ones mentioned in table 2 between a particular musical instrument and its fillers, and *implicit* links, such as the classical lexical relation of synonymy, for instance, which can be derived from the information found in the explicit links and nodes. For example, that *aids* and *acquired immune deficiency syndrome* are synonyms can be derived from the fact that both show the same fillers for the same slots, namely:

SLOT	FILLER
cause	virus
affected function immune	system
affected organism	body
transmitter	blood

This way *aids* and *acquired immune deficiency syndrome* will have the same place in the network.

In the same vein one can now hypothesise that, ideally speaking, underlying any type of dictionary, there is a frame-based lexicon or a lexical knowledge basis (LKB) as the one outlined above and from which dictionary entries can be derived. In what follows we will try to make clear which advantages could be drawn from such a frame-based lexicon (an instantiation of a LKB) for the construction of learner's dictionaries.

5 Learner's dictionaries

The following definition of (advanced) dictionaries for foreign language learners will be used: 'An advanced learner's dictionary is a dictionary meant for L2-users with the aim to give them a thorough command in L1 of the most important linguistic functions (needs), viz. to understand, to speak, to write and to read in the FL. The dictionary, moreover, has to take into account both the specific difficulties of the prospective user and his specific skills (both reference and language skills). Finally, in order to be a true learner's dictionary, the dictionary has to be compatible with or part of an accepted language teaching method.'

In the next section we will demonstrate that a frame-based dictionary offers good opportunities to reach the aims set out above.

The underlying assumptions we start from are the following:

• in order to further better understanding in the FL, learner's dictionaries should make use of the most adequate definitions, including other than verbal ones;

• in order to provide for better production in the FL, learner's dictionaries should provide the learner with the most typical collocations;

• in order to help better retention, learner's dictionaries should not (only) present lexemes in alphabetical order, but (also) order them thematically;

• in order to further better communication, learner's dictionaries should not be coupled loose from language didactics and from language learning methods in general.

Elaborating all the issues mentioned above thoroughly would lead too far. Instead we will briefly indicate for each of the above statements which advantages, in our opinion, a frame-based approach can offer for the elaboration of learner's dictionaries.

5.1 Definitions and illustrations

It may seem obvious that frame-based definitions should lead to more consistent and more complete definitions. In a frame-based approach *word tokens* are no longer defined in isolation but as belonging to a *type* (leading to greater consistency). Furthermore, as the type predicts the possible slots for the token, the latter can be treated more fully.

However interesting the two above-mentioned features may be, in a didactic context another feature of frames could even prove more useful, namely their flexibility. In this respect a frame is rather than a pre-stored, rigid list of features, a dynamic structure which can be tuned according to the different needs of the user. Instead of having to *select* the same slots, the dictionary maker can *select from* the same slots, having the possibility to take different views/perspectives on the same object, thus stressing different aspects depending on the user's needs. It is, for instance, quite possible that the definition of a lexical item such as *aids* differs according to whether it is meant for experts or for laymen, though based on the same set of slots.

In the same vein, one can observe that frames (and frame-based definitions) offer the lexicographer the possibility to make different categorisations depending on the slots he takes as his starting point. Depending on the knowledge level of the target group, a *banjo*, for example, can be classified (see table 2) as:

• a stringed instrument (the *has-part* slot)
• a plucked instrument (the *manner-of-play* slot)
• a kind of guitar instrument (the *similarity* slot)

The same flexibility one observes with regard to contents can also be observed with regard to form or mode of representation. Taking into account the difficulty one often encounters when one has to explain words by means of other words, one can also conceive of a learner's dictionary as a multimedia lexical database with frames as the steering force to guide the process of both storing and selecting the adequate mode of semantic representation.

The figure below, taken from Fernandes (2004) illustrates the idea. Because of the fact that frames show certain slots (e.g. *direction, intensity, sound* etc.) or belong to a certain type (e.g. *food, body parts, clothes* etc.) they can trigger not only verbal modes, but also various non-verbal representation modes as well.
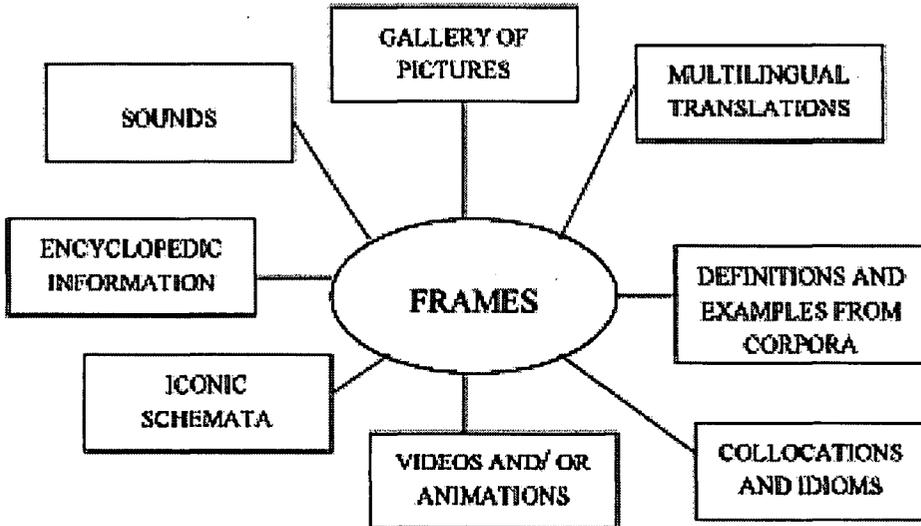
Figure 1. A model for a Multimedia Lexical Database (from Fernandes (2004: 247)).

Indeed, if one considers frames to be deep, underlying, abstract structures of knowledge representation, not oriented towards *one* concrete, particular mode of representation, then the latter are but derivations of what is to be found in the frames. What is then needed further are derivational criteria (*how can* one derive a particular mode from an underlying frame?) and selectional mechanisms (*when should* one select it?). In Fernandes (2004) this is further elaborated upon in two steps as suggested above. In a first instance the slots of the frames are used as conditions in condition/action rules to denote what is conceptually possible. In Fernandes' own words:

'[the] slots will be the key to our 'if/then' rules, since they will be linked to the different galleries of knowledge representation media and constitute our *conceptual* criteria as to what *can* be illustrated, if needed.' (Fernandes (2004: 279))

In other words, if, for instance, the slot *direction* is filled in with a verb of movement then

'the illustration modality to be used, according to the token in question, can be a video, a drawing (...) or an iconic schema (when scales, intensities or contrasts are involved, for instance).' (Fernandes (2004: 280))

In a second instance, moving from what *can* to what *should* be illustrated, involves next to *conceptual* criteria also *functional* criteria:

'Definitions represent knowledge and human knowledge is firstly based on perception. If perceptual knowledge is much harder to reproduce in words than in an ostensive non-verbal way, then the main
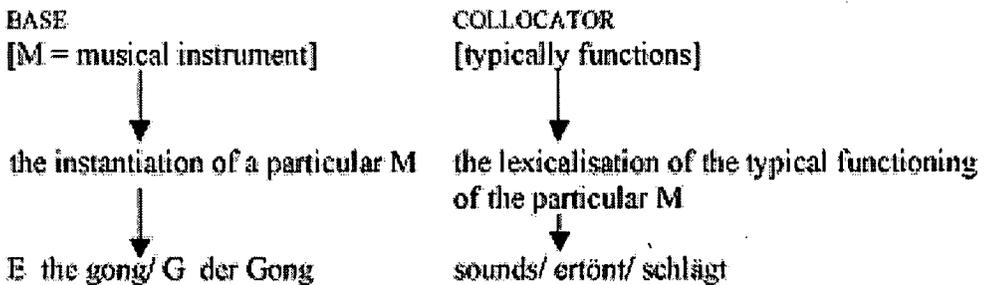
difficulties in defining some types of words with other words constitute the *functional* criteria for us to propose their multimedia illustration. In other words, we are no longer dealing with items that *can* be illustrated, but with those that *should* be illustrated.' (Fernandes (2004: 284))

An example of such a *functional rule* (as opposed to the *conceptual* ones) is, for instance, the degree of difficulty involved in 'verbs implying sounds (a door *creaking*; ashes *crackling*; glasses *clinking* for a toast) as well as [in] names or adjectives related to sounds (a *cry*, a *shrill* voice)' (Fernandes (2004: 285)).

5.2 Collocations

The advantages of frames do not lie on the level of representation (see the preceding section) only, but on that of production as well. Everybody who has ever learnt to speak a foreign language knows how difficult it is to reach native speaker level with regard to collocational use. The lexicographer has in a way to construct a collocation dictionary for the learner. It does not suffice to simply take a corpus and select the most frequent combinations from it. For one reason or another, frequency and relevancy do not show a one-to-one relationship here. Frames can help to overcome this difficulty in that they can, in abstracto, predict potential/virtual collocations, a 'collocational pattern', and can be used to explore corpora with.

The example below will clarify what is meant. The fact that in the frame of MUSICAL INSTRUMENT the *function* slot is present and plays an important role, will, for instance, open up the possibility of having a collocational counterpart such as:

BASE
[M = musical instrument]
↓
the instantiation of a particular M
↓
E the gong/ G der Gong

COLLOCATOR
[typically functions]
↓
the lexicalisation of the typical functioning of the particular M
↓
sounds/ ertönt/ schlägt

One can then infer from the slots given for MUSICAL INSTRUMENTs in table 2, among others, the following collocation types:

function (musical instrument) = ?
not function (musical instrument) = ?
cause (better) function (musical instrument) = ?
dysfunction (musical instrument) = ?

function well (musical instrument) = ?
make sound (musical instrument) = ?
use (musical instrument) = ?

The expressions above should be read as: how does one express in language L the typical functioning of musical instrument M, of musical instrument M' etc.; how does one express the typical sound made by musical instrument M, by musical instrument M' etc.

In the concrete case of, for instance, *Gong* (E. *gong*), *Trompete* (E. *trumpet*) and *Geige* (E. *violin*) this leads to the following *collocational pattern*:

- function
    - → [M] [typically functions] e.g. der Gong ertönt/schlägt
    - → [M] does not function e.g. der Gong schweigt
    - → X [causes to function better] [M] e.g. eine Geige stimmen
    - → [M] [functions well] e.g. die Geige hat einen guten Klang
    - → [M] [typically malfunctions] e.g. die Geige klingt falsch
- sound
    - → [M] [makes typical sound] e.g. die Trompete schmettert
- user
    - → X [typically makes use of] [M] e.g. (auf der) Trompete blasen

The above is meant to make clear that a *frame*, bound to a particular type, does not only systematize the description of meaning, but that of combinations and collocations in particular, as well. Of course not all combinations mentioned above will be regarded as collocations in the same degree. This depends on what we have called elsewhere (Martin, (to appear)) the degree of *boundness* (*token* vs. *type* vs. *non*-boundness) of collocational candidates. So, for instance, the above-mentioned collocational patterns will be classified as in figure 2 below:
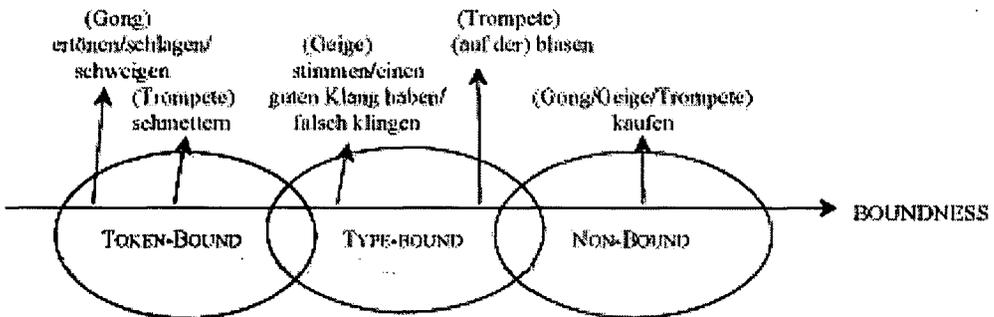

Figure 2. Lexical Collocations ordered to degree of boundness.

If learner's dictionaries do not only want to be explanatory but productive devices as well, they should make use of a systematic approach to collocations. A frame-based approach offers the possibility to elicit this collocational knowledge from knowledge sources (e.g. corpora and/ or informants) and so acts as a heuristic instrument also. Of course, ultimately a user model is needed in order to find out what is redundant/informative given the knowledge level of the intended users.

5.3 Thematic organisation

It is generally accepted that learning words in context and coherent sets supports both learning and retention.

In a project called *Leerwoordenboek Zakelijk Nederlands* (Learner's Dictionary of Business Dutch) the Lexicology/Terminology Research Group of the Vrije Universiteit Amsterdam, in co-operation with the Subdepartment of Dutch of the University of Louvain-la-Neuve, Belgium, has been working on a project in which items from the business world are treated and, among other things, grouped into semantic families. These semantic families consist of a family head and family members. The identification of both head and members is done by means of frame-based definitions. Indeed, frames, although they do not univocally refer to a family head, offer a list of candidate heads from which one can be selected as a head. Whether a lexical item will become head of a family or not is not only a matter of frequency (the number of times the item appears as a filler in the frame of another item), but also a matter of salience or relevance. So, for instance, taking three items from the financial sector, viz. *share*, *company* and *shareholder*, as a case-in-point, just as in cognitive linguistics, a basic level item as *share*, all other things being equal, will be preferred as family head to the more general item *company* and the more specific item *shareholder*.

As far as the family members are concerned, these are items which are related to the family head by means of synonymy, antonymy, hyponymy or another semantic relation. They can be found in two ways. First of all, they may refer to the family head, in the sense that one of the fillers of their slots is the family head. Secondly, the family head itself will call for (part of its) members.

Further ordering within the family is done by means of the (concept) types the family members (tokens) belong to. In this way the user can see in the case of the family *aandeel* (share), for instance, which persons, organisations, activities, results (such as income and taxes) etc. play a role in the field centred around the family head, see table 3 below.

aandeel (share)	(TYPE: waardepapier [security])
• SYNONYM (of ~)	aandeelbewijs (share certificate)
• HYPONYM (of ~)	aandeel aan toonder (bearer share)
	aandeel op naam (nominative share)
	preferent aandeel (preference share)
• PERSON (related to ~)	aandeelhouder (shareholder)
	grootaandeelhouder (large shareholder)
• ORGANISATION (related to ~)	aandeelhoudersvergadering (shareholders' meeting)
• ACTIVITY (related to ~)	inschrijven op aandelenemissie (subscribe for share issue)
• INCOME (from ~)	bonus (bonus)
• TAX (on ~)	dividendbelasting (tax on dividend)
. etc.	

Table 3. Part of the Family *aandeel* (share) (adapted from Maks & Martin (2004)).

5.4 Integration into a language learning framework

In the beginning of section 5 we have argued that, ideally speaking, a learner's dictionary should not be a stand-alone component, but integrated into a larger language learning framework.

From work done by one of my PhD students, Martha Hofman, although still in an early stage, one can already observe that frames can offer interesting possibilities here.

In her work Hofman starts from a functional communicative approach to language learning. Two examples (in Dutch) are given to illustrate what is meant.

Function 1: Iets in een winkel/ op de markt kopen [Buy something in a shop/ on the market place]
    Phrase 1: Mag ik [...]?
    Phrase 2: Ik wil graag [...].
    Phrase 3: [...], graag.
    Phrase 4: [...], alstublieft.

The phrases are options for opening phrases with which to order/ buy something. The empty square brackets refer to slots which, typically, can be filled by frame types, for instance CLOTHING, FOOD AND DRINKS etc. In Hofman's annotation this looks as follows:
Possible slots for the phrases are:[2]

kleding	→	broek, overhemd, trui, ...		
eten en drinken	→	groente en fruit	→	sla, bloemkool, druiven, ...
eten en drinken	→	dranken	→	wijn, koffie, sinaasappelsap, ...

From the above, it becomes clear that frames can function well in such a functional-communicative environment. First of all, Hofman's slots correspond to the concept types that frames are bound to (see section 2). This way, frames provide Hofman's slots with more appropriate fillers (such as: *jurk, blouse, spijkerbroek* [dress, blouse, blue jeans] etc. in the case of CLOTHING).

Secondly, frame-based lexical items are not only grouped into categories/ types which can match with the slots the didactic approach requires, they are also 'decorated' with the collocational information that is needed for the user to correctly produce the language in question (see section 5.2).

So, for instance, the first function, when filled with items from the class FRUIT AND VEGETABLES can profit from the fact that in voce *sla* (lettuce) and *druiven* (grapes) collocations will be found which singularise resp. group the items in question into *een krop sla* (a head of lettuce) and *een tros druiven* (a bunch of grapes). A frame-based lexicon requires these collocators to occur and so can act as an adequate lexical complement for the functional slots used here.

Another example taken from Hofman shows that also the thematic organisation (organisation in families, cf. the previous section) can be integrated in the functional approach.

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[2] The examples in English translation are:
    clothing → a pair of trousers, shirt, sweater
    food and drinks → fruit and vegetables → lettuce, cauliflower, grapes
    food and drinks → drinks → wine, coffee, orange juice.

Consider the function 'Vragen naar openbaar vervoer' (Asking for public transport) in which different family members can play a role:

Phrase 1: Hoe laat vertrekt de bus/ trein/...?
(At which time does the bus/... leave?)
...
Phrase 4: Waar is de bushalte/ de tramhalte/ het station/ het metrostation/ busstation/ ...?
(Where is the busstop/...?)
...
Phrase 6: Waar kan ik een kaartje/ retour/ enkele reis kopen/...?
(Where can I buy a ticket/...?)

Starting from a family head as *trein* (train), one can expect frames to yield members (fillers) from the type (slot) location, agent, document etc. Here too, one may observe that the better a lexicon is organised both paradigmatically and syntagmatically, the better the prospects are for an efficient integration into a didactic language framework.

6 Conclusion

In the predeeding sections we have tried to make clear that representation models such as frames can help in the elaboration of more adequate learner's dictionaries, in that they can lead to
• definitions that are more adequate for the intended user;
• collocational patterns from which one can more systematically select;
• orderings that are not just alphabetical, but thematical as well;
• and a firmer embedding in language learning methods.

Yet, in order to yield a truly ideal learner's dictionary, an adequate user model in which both needs and skills of users are accounted for, still remains a conditio-sine-qua-non.

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