12 Frames

In this book, it is assumed that meanings are concepts. We have talked a lot about the content of these concepts and the relations among them. We have learnt about general aspects of categorization and concept formation. But up to now, no proposal has been presented as to what these concepts are like: What is their structure? What are their conceptual components? This will be finally done in this chapter, though the answer to these questions is, necessarily, preliminary and incomplete. There is one theory of concepts in cognitive psychology which has come up with a concrete model of concepts: Barsalou's theory of cognitive frames[1]. The theory claims that all concepts in human cognition are 'frames' and presents various empirical evidence and theoretical arguments in favour of this claim. Barsalou's theory of cognitive representations is superior to the binary feature approach (BFA) as well as to prototype theory. Unlike BFA, it is much less restricted; unlike prototype theory, it is explicit about the internal structure of concepts. It is very attractive for linguists, as it offers solutions for many problems of decompositional semantics; it also offers a possibility for tackling semantic composition. The application of frame theory in semantics and in linguistics in general is still under development, but there is enough to be said about this promising theory of cognitive representations in order to include it here.

12.1 Barsalou frames

12.1.1 Chunks of knowledge

The notion of 'frame' belongs to a family of similar notions, including 'schema', 'scenario' and 'script', that came up in the 1970s in the fields of artificial intelligence and cognitive science. These were notions for the ready-made complex 'chunks of knowledge' which we apply in everyday life. For instance, there is the schema (or frame) 'university'; it consists of the typical 'ingredients' of a university, like its campus, its faculties, its teachers, lectures, students, courses and study programmes, examinations, etc.; or the ‘family’ frame that defines the members of a family, the relationships between them, their responsibilities, etc. There is the 'script' or 'scenario' of a children's birthday party or of dining at a restaurant, shopping in a supermarket, taking an exam or being married. Such a framework is defined by constitutive ingredients such as persons in specific roles, engaged in particular interactions, pursuing certain aims, etc.; their actions will involve certain objects and locations, they may be undertaken in a particular order, etc. Just think about eating in a cafeteria: we have the kind of location with its fittings and furniture that would make up a cafeteria, the staff and other customers that will be there, the kind of food and beverages you may find, the procedure applied to get your meal, pay for it, take a place, eat and drink and dispose of your rubbish. Chunks of knowledge like the cafeteria schema form our general world knowledge. They are tacitly employed as background knowledge when we mention visiting a cafeteria or other activities. There is no doubt that our cognitive systems host a vast number of such chunks of knowledge which are interwoven which each other and allow us to activate large networks of knowledge in a very short time.

In the literature on artificial intelligence or cognitive linguistics, no precise formal definitions are provided for a general format of such chunks of knowledge.[2] Barsalou was the first

1 The theory was introduced in Barsalou (1992a, 1992b).

2 For example, Kövecses (2006:64) gives the following working definition of frames: "A frame is a structured mental representation of a conceptual category."

to come up with a model of considerable precision and with the claim that this is the actual format in which our minds organize concepts to represent the categories of things and phenomena in the world. Barsalou's is not primarily a theory of semantic representations. Much of his empirical work was spent on concept formation in particular contexts and experimental settings. He emphasizes that concept formation is flexible and able to adapt to the needs and circumstances of a given situation. Concepts can be arbitrarily enriched or thinned out or otherwise modified. This general flexibility does not apply, though, to stored lexical meanings, which is what we will frame theory apply to. Lexical meanings form stable cognitive entries only subject to the general process of lifelong language learning.

Barsalou frames are cognitive representations of single objects, either individual objects or objects as members of a category. Compared to these frames, the chunks of knowledge envisaged in artificial intelligence are macrostructures that integrate a greater number of objects, events, actions, etc. in a much more complex whole.

12.1.2 The passport frame

The general notion of a frame (henceforth 'frame' is to be understood as 'Barsalou frame') can be illustrated by means of an example we all know: the information that is provided in a passport for the identification of its bearer. Passports issued by a certain country use a fixed paradigm of description for the holder. The example we will give is based on the European Union passport (as of 2012); it contains the following data on its bearer: name, given names, nationality, date of birth, place of birth, sex, residence, height and colour of eyes; these are specified in words. In addition, there are two non-verbal pieces of information: a token of the bearer's signature (this is primarily non-verbal because it's the mere written shape that matters, readable or not), and a photograph of the bearer's face. In the context of frames, these parameters of description are called **attributes**; we will use small capitals for attributes. The attributes take **values**, e.g. the value *Angelika* for the attribute GIVEN NAMES or the value 'female' for the attribute SEX. The values can be of various kinds, depending on the attribute. It may or may not be possible to describe the values in words (a signature or a face cannot be *described* in words, although it can of course be referred to). Figure 12.1 gives the data in a fictitious pass-

bearer	.name	: Postowski
	.GIVEN NAMES	: Angelika
	.NATIONALITY	: German
	.DATE OF BIRTH	: 03.08.1971
	.PLACE OF BIRTH	: Bottrop
	.SEX	: female
	.HEIGHT	: 178 cm
	.COLOUR OF EYES	: blue
	.RESIDENCE	: Köln
	.SIGNATURE	: (*a signature*)
	.[FACE]	: (*a photograph*)

Figure 12.1 Frame matrix for an EU passport bearer (1)

port in a frame matrix.

The bearer appearing as the only entry in the first column is the object that the whole frame describes; all entries in the second column relate to this item. The second column of the matrix lists the attributes, the third column the values they take. Each line represents one piece of information about the bearer; for example 'bearer.NAME: Postowski' which is to be read as 'the name of the bearer is Postowski', or 'bearer.COLOUR OF EYES: blue'. The attribute FACE is given in square brackets because it does not appear explicitly in the passport.

The matrix contains eleven attributes of the bearer and their respective values, as far as they that can be verbalized. Four of the attributes take a complex formulation: date of birth, place of birth, colour of eyes and signature of bearer. The last one makes explicit the possessor of the attribute which is left implicit in all the other cases. The other three entries can be decomposed into two steps of attributing. The term 'colour of eyes' refers to the colour of the eyes of the bearer; this is, in a first step, the value of the attribute colour of the eyes of the bearer; in a second step, the eyes of the bearer can be analyzed as the value of the attribute eyes of the bearer. Thus, the attribute colour of eyes is the result of a chain of two attributes; it is the attribute colour of the value of the attribute eyes of the bearer. This decomposition is given in (1a). The attributes place of birth and date of birth can analyzed as involving the attribute birth of the bearer. They can be analogously decomposed as in (1b, c):

(1) a. bearer.COLOUR OF EYES: blue
= bearer.EYES: [bearer's eyes].COLOUR: blue

b. bearer.DATE OF BIRTH: 03.08.1979
= bearer.BIRTH:[bearer's birth].DATE: 03.08.1979

c. bearer.PLACE OF BIRTH: Bottrop
= bearer.BIRTH:[bearer's birth].PLACE: Bottrop

The attributes BIRTH and EYES open two small subframes for their respective values; one represents the birth of the bearer with the attributes DATE and PLACE, the other, the eyes of the bearer with the only attribute COLOUR. These subframes can be unfolded in the frame matrix as in Figure 12.2.

bearer	.NAME	: Postowski		
	.GIVEN NAMES	: Angelika		
	.NATIONALITY	: German		
	.[BIRTH]	: [bearer's birth]	.DATE	: 03.08.1971
			.PLACE	: Bottrop
	.SEX	: female		
	.HEIGHT	: 178 cm		
	.[EYES]	: [bearer's eyes]	.COLOUR	:blue
	.RESIDENCE	: Köln		
	.SIGNATURE	: (*a signature*)		
	.[FACE]	: (*a photograph*)		

Figure 12.2 Frame matrix for an EU passport bearer (2)

The example illustrates a very important property of frames: they are in principle recursive, i.e. frames may contain embedded subframes which add information on the value of an attribute by adding to it its own attributes and their values.

The basic unit of frame description is the ascription of an attribute and its value to either the **referent** of the whole frame, or to the value of an attribute in the frame: a piece of information of the form '_____.ATTRIBUTE: value'. Frames can not only be represented by matrices, but also by graphs of nodes and arrows. This mode of representation is more space-consuming, but it is easier to read. In a frame graph, the object of representation and the values of attributes are represented as nodes. The node representing the object of description of the whole frame is encircled with a double line; it will be called the 'referent node'. Attributes are represented by labelled arrows to the value; the arrows carry a label naming the attribute. Thus, the basic unit in a frame graph takes the form shown in Figure 12.3. The node to which the attribute is applied is represented by a broken line circle; we will refer to it as the 'possessor' of the attribute.

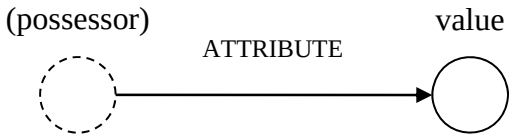


Figure 12.3 Attribute-value element of a frame graph

Figure 12.4 displays the graph equivalent of the frame matrix in Figure 12.2.

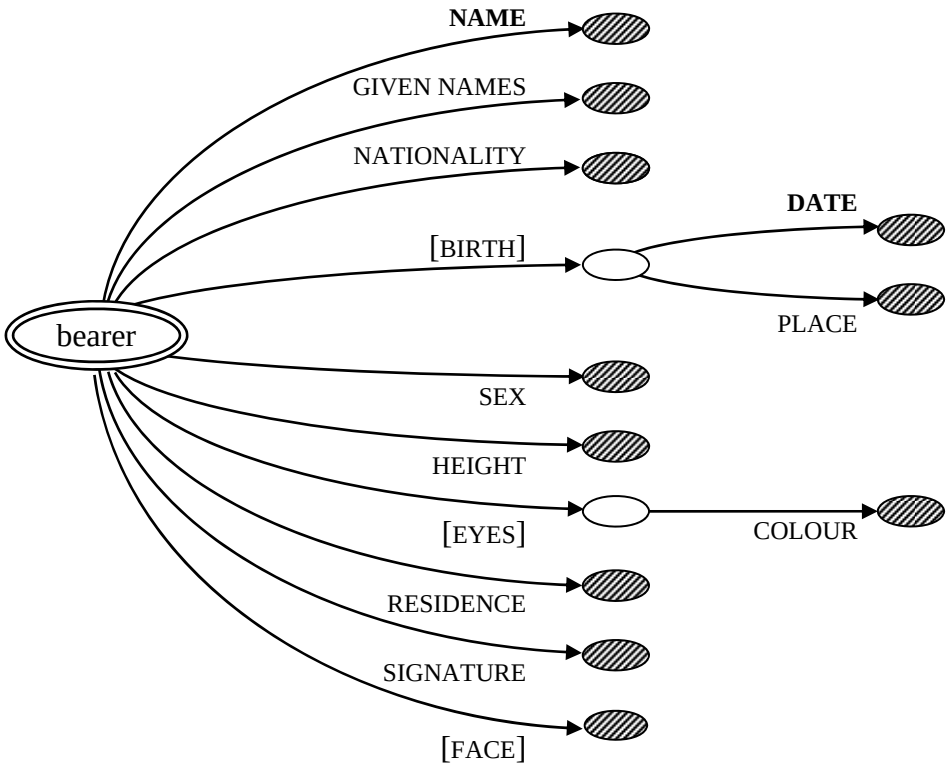


Figure 12.4 Frame graph for an EU passport bearer

A passport contains not only information about the bearer, but also about the document itself. It specifies, among other details, a unique passport number, a type (= 'P'), dates of issue and of expiry, the issuing authority – and of course the bearer. The bearer is an attribute of the passport, and thus the whole bearer frame can be regarded as embedded in a superordinate passport frame. This is depicted in the frame matrix in Figure 12.5. The frame box containing '[bearer]' indicates the frame matrix in Figure 12.2.

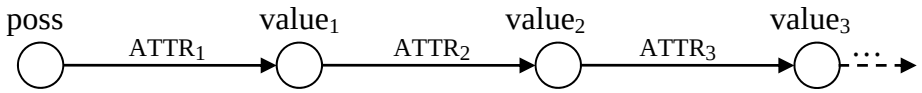
passport	.NUMBER	: xxxxxxxxx
	.TYPE	: P
	. DATE OF ISSUE	: 16.03.2012
	. DATE OF EXPIRY	: 15.03.2022
	. AUTHORITY	: Stadt Köln
	. [BEARER]	: bearer …. …. ….

Figure 12.5 Frame matrix for an EU passport

As we saw with the examples of DATE OF BIRTH and COLOUR OF EYES, attributes can form chains; the general structure is as in (3a), graphically as in (3b).

(2) a. possessor.ATTRIBUTE_1:value_1.ATTRIBUTE_2:value_2.ATTRIBUTE_3:value_3 …

b.



The passport frame is an example of what is called 'institutional categorization', i.e. a socially established standardized way of categorization. There are countless other examples essentially in frame format, e.g. telephone registries or library catalogues, where each entry amounts to a frame format description with the same attributes. We actually used a frame in 3.1 above when we defined the notion of the lexeme. It can be transformed into a frame matrix such as in Figure 12.6.

lexeme	.SOUND FORM	: ['ti:tʊ]
	.WRITTEN FORM	: 'teacher'
	.MEANING	: ›teacher‹
	.CATEGORY	: noun

Figure 12.6 Frame matrix for the lexeme 'teacher'

In this lexical frame, the entry for the value of the attribute meaning would have to be filled by the frame representing the complex concept for a teacher.

12.1.3 The basic structure of a frame

A frame is the description of a potential referent. This can be a particular object, as in the passport example, or an arbitrary member of the category described – if the frame is not specific enough to single out a particular case. In the applications considered in the following, frames will always be of the latter kind. The potential referent of the frame is represented by the referent node in a frame graph or by the only element in the first column of a frame matrix. The frame contains attributes; these assign a value each to the potential referent; further attributes may assign values to these values and so on. The frame structure is subject to a set of uniqueness conditions; these are the essential conditions that define a frame. For different types of concepts there may be additional conditions imposed on their structure:

DEFINITION 1
A **frame** is a conceptual network of attribute-value assignments that fulfils the following uniqueness conditions:

UR Unique frame referent
There is a unique element that represents the potential referent of the frame. Every element in the frame is connected to the frame referent by a chain of attributes.

UA Unique attributes
For each element in the frame, an attribute is assigned no more than once.

UV Unique values
For each element in the frame, and each attribute applied to it, the attribute takes a unique value.

If you take a look at the examples, you see that UR is fulfilled: there is a particular element representing the referent and all other elements are connected to it. In a frame matrix, the central element is represented by the only entry in the first column; in a frame graph, the central element is the node marked as a double-lined node, from which every other node can be reached.

For each element in the frame, the same attribute is never applied more than once (UA). Also, the attributes are understood as taking a unique value (UV). The value may be complex; e.g. the value of GIVEN NAMES may be a series of two or more given names; but then the whole constitutes one value of the attribute. The value of an attribute need not be specified with ultimate precision, it may even be left open in certain cases; for example, in a frame for the concept ›person‹, one might provide for the attribute SEX without fixing its value. However, the attribute must be such that for a given possessor it returns exactly one value.

12.1.4 Attributes are functional concepts

It follows – and this point is of utmost importance – that ATTRIBUTES ARE FUNCTIONAL CONCEPTS. If Barsalou is correct in assuming that frames are *the* format of cognitive representations, it follows that our mental descriptions of objects and categories are entirely in terms of functional concepts and the values they take. Functional concepts correspond to functions in the mathematical sense in that they return a unique value for any given argument. The only difference between attributes and mathematical functions is that the arguments and values of attributes are not restricted to mathematical entities such as numbers, sets, functions, etc; arguments and values of attributes can be of any type whatsoever. Attributes are subject to something like selectional restrictions: they can be applied only to a certain domain of cases. For example, the attribute SEX can only be applied to certain organisms, HEIGHT only to objects with a vertical extension, NAME only to named objects, and so on. Also, attributes take certain types of things as values. For example, SEX takes the values 'female' or 'male', HEIGHT

a measure of length, NAME some verbal expression subject to complicated social conventions of naming.

We already encountered functional concepts when we dealt with functional nouns in 4.4.2.1: the meanings of functional nouns are functional concepts. If you look at the attribute terms in the passport example, you will realize that, in the readings used in the passport, these are functional nouns: they are relational in that they need a possessor argument for determining their referents and they refer to exactly one referent for a given possessor. The text of the passport contains the functional nouns *name*, *nationality*, *birth*, *date*, *place*, *sex*, *height*, *colour*, *residence* and *signature*; except for *signature*, they come without a possessor specification because they are tacitly understood as relating to the bearer of the passport. The noun *name* in the combination *given names* is used as a relational noun; obviously, the plural admits for more than one referent. However, in the plural, referring to the totality of given names, it provides a functional concept. Similarly, the relational concept ›eye‹ yields a functional concept ›eyes‹ when turned into the plural.

Since attributes are the elementary element of frame composition, frames for attributes themselves are extremely simple. A frame graph for an attribute contains a single arrow, labelled for that attribute. It originates from a node that represents its possessor, or argument. Since this argument is to be filled, we represent it not with a circle, but with an empty rectangle. The attribute links the argument to its value. The value forms the referent of the frame. This corresponds to the fact that for an expression such as *price of oil*, *price* expresses a functional concept to be applied to the referent of *oil*; the whole expression refers to the value of the 'price' function for oil, i.e. to the price of oil. Figure 12.7 displays the general frame graph for an attribute concept.

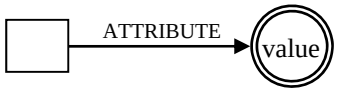


Figure 12.7 Frame for an attribute

The chaining of attributes mentioned above, repeated in (3a) corresponds to the chaining of the underlying functions (3b); the mechanism of chaining mathematical functions is known as 'function composition' in mathematics.

(3) a. possessor.ATTRIBUTE_1:value_1.ATTRIBUTE_2:value_2.ATTRIBUTE_3:value_3

b. $f_3(f_2(f_1(x)))$

The chaining mechanism of functions and attributes is replicated in language by the possibility of forming possessive chain constructions like in (4a) and, less elegantly, in (4b). The order of elements in (4a) corresponds to the order in (3b), the order of the Saxon genitive chain, to (3a):

(4) a. the colour of the eyes of the bearer of the passport

b. the passport's bearer's eyes' colour.

The passport frame has terms for each attribute (except for FACE) that it specifies, and these terms are functional nouns or complex expressions with functional concept meanings, in the readings relevant here. While this is necessary for frames of institutional categorization, we cannot expect that there will be words to label all the attributes that figure in all the frames

we supposedly employ in our cognitive systems. On the contrary, it is to be expected that for most, if not almost all, attributes we do not have a functional noun in our lexicon. As we stated in 11.1, cognitive representations are not in terms of words.

12.1.5 Types of attributes

Possible attributes in frames can be classified into four basic types according to the types of values they assign. All four classes are instantiated in the passport frame: (i) constitutive part attributes, (ii) correlate attributes, (iii) property attributes and (iv) event attributes.

Part attributes. Frames for the representation of complex things like cats or pianos have attributes for their constitutive parts. They contain a mereology of the object (recall 8.4.4). For example, a frame for a person will contain a subframe for the body, which in turn will contain two embedded subframes for the arms, each with a sub-sub-frame for the hand containing the attributes PALM, THUMB, INDEX FINGER, etc., each of them with their own mereologies. Due to UA, a frame must not contain the same kind of attribute more than once for one possessor. Thus, in the mereological subframe for the body, there must not be two attributes ARM, but different attributes such as LEFT ARM and RIGHT ARM. The values of the part attributes are the respective parts of the whole (the value of the attribute HEAD in a cat frame is the head of the cat). The constitutive parts of a whole do not exist independently; if the whole is given, its parts are too. In the passport frame, there are two part attributes, the attributes EYES and FACE of the bearer.

Correlate attributes. Correlate attributes specify things of independent existence to which the referent of the concept is uniquely related. For pianos this may be attributes such as PRODUCER or OWNER; for cats it might be MOTHER or OWNER. Correlates enjoy an existence independent of the concept referent. The passport example contains six correlate attributes: BEARER, NUMBER and AUTHORITY for the passport; NAME, GIVEN NAMES and RESIDENCE for the bearer.

Property attributes. This group is instantiated in the passport frame by the attributes TYPE of the passport, NATIONALITY, SEX and HEIGHT of the bearer and COLOUR of the bearer's eyes. The values of property attributes are of an abstract nature. They may be located on a scale, such as in the case of HEIGHT, LENGTH, WIDTH, SIZE, WEIGHT, AMOUNT, QUANTITY, TEMPERATURE, PRICE, WORTH, VALUE, DURATION, EXTENSION, etc. or not, as with the attributes NATIONALITY, SEX, COLOUR, SHAPE, CHARACTER, NATURE, MEANING, FORM, etc.

Event attributes. This is a somewhat imprecise class of attributes that link the possessor to events and activities. In the passport example, we encountered the implicit attribute BIRTH of the bearer; there is also the implicit attribute ISSUE of the passport which is involved in the attributes DATE OF ISSUE and also in AUTHORITY, as this is meant to denote the issuing authority; finally there is the implicit attribute EXPIRY. The values of these attributes are events uniquely connected to their 'possessors': there is only one birth per person and one issue and expiry per passport. The attributes of the values of event attributes (e.g. of the birth of the bearer and the issuing of the passport) are thematic roles of the events: LOCATION (in PLACE OF BIRTH), TIME (in DATE OF BIRTH/ISSUE/EXPIRY) and AGENT (in [ISSUING] AUTHORITY). Later we will see that there is another group of event related attributes: those specifying manners of interaction with the referent of the frame or parts of it. As we saw with basic categories in 11.3, manners of interaction are an important aspect of categorization.

12.1.6 Constraints

Each attribute in a frame takes values from a certain set of alternatives. These alternatives are constrained. First, an attribute returns values of a certain type, e.g. a date, a name of a person, a measurement in centimetres, etc. Then, among the logically possible values, it may be the case that only some are eligible. In the case of the passport frame attributes, the attributes underlie constraints such as these:

- HEIGHT: possible heights of persons;
- DATE OF BIRTH: dates in the past that result in a possible age of the bearer;
- GIVEN NAMES: names admissible as given names for persons
- NAME: a registered family name
- COLOUR OF EYES: a colour possible for human eyes
- FACE: a photographic picture that looks like a human face

In some cases, the choice is constrained to a fixed and closed set of alternative values, e.g. for the attributes SEX and NATIONALITY of the bearer and TYPE of the passport.

Further constraints on the values of arguments arise from the fact that the values of attributes may depend on, or correlate with, the values of others. For example, sex and nationality of the bearer constrain the possible values of the attribute GIVEN NAMES, at least in some countries (a male German bearer cannot have 'Angelika' as an entry for his given name). Sex and age will constrain to a certain extent what the face of a person may look like; the name and given names correspond to a certain, if often modest, extent with the shape of the signature, and so on. These constraints apply to the passport frame in general; their violation would result in an inconsistent or at least implausible description. In the rest of this chapter we will leave constraints more or less aside. This part of frame theory is not as well developed as the theory of attributes and values.

We will now turn to various applications of Barsalou frames in semantics, first looking at verbs (12.2) and then at nouns (12.3).

12.2 Verbs and frames

12.2.1 Verbal argument frames

The argument structure of a verb is simple straightforward frame; the referent is the referential argument of the verb; the attributes are the thematic roles of the arguments. In fact, such argument frames were the first examples of frames discussed in linguistics in Fillmore (1968) and are an important precursor to the more general present notion of the frame. Fillmore ob-

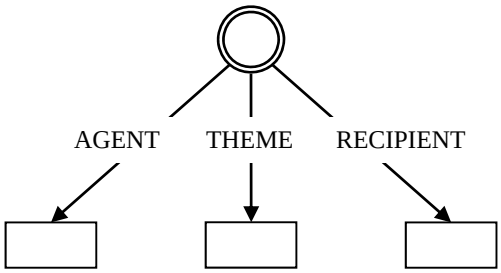


Figure 12.8 Frame graph of the argument structure of ditransitive verbs

served that each argument of a verb is of a different general role (he called them 'cases') and that each of the general roles can occur only once in a sentence. Given that any argument is only specified once in a sentence, argument frames satisfy the three uniqueness conditions in Definition 1: there is a central element (UR), each role can occur only once (UA) and the roles correspond to exactly one argument (UV). Figure 12.8 shows the argument frame for a ditransitive verb like *give* or *send*. In the figure, the argument nodes are indicated by rectangles rather than circles. Rectangles are used for open argument elements in a frame (except for referential arguments).

From the perspective of frame analysis it is not only natural, but in fact necessary to assume that verbs have a referential event argument (recall the discussion in 5.3.2): it is the possessor of the argument attributes.

Condition UA is responsible for a constraint on the argument structures that is otherwise unexplained: a verb cannot have two equal semantic roles – even if the event denoted involves participants that play equal roles in this kind of situation. For most two-place or three-place verbs, the roles of the arguments are clearly different; for example with 'hit'; the AGENT and the PATIENT are clearly involved in the event in very different ways. However, there are reciprocal (8.3.6) verbs such as *struggle*, *agree* or *correspond* where the interacting participants factually play the same role. Yet they have to be assigned different semantic roles and linked differently, e.g. as subject and *with*-PP; alternatively they can be both packed into a conjunction and linked as subject (recall Levin's *marry* class of verbs discussed in 6.1.3).

It must be cautioned that an argument frame is still a long way off representing the full meaning of the verb. Hundreds if not thousands of verbs may have the same argument frame. The argument frame contains little information about the event itself, the kind of process or action it denotes. Also, these 'flat' argument frames, where all arguments are directly assigned as attributes to the referent, fail to reflect possible conceptual dependencies among the arguments. For example, a verb like *go* in the construction '*go from A to B*' would have a similar structure: three argument attributes, in this case labelled AGENT, SOURCE and GOAL. While these three attributes are represented on a par, they are in fact conceptually dependent on each other: the SOURCE is the LOCATION OF AGENT at the beginning of the event and the GOAL is the LOCATION OF AGENT at the end. How this can be modelled in frames is not yet settled. More generally, the problem of modelling the situation structure of an event (recall 6.2), e.g. initial and resultant condition, is not yet solved. Nevertheless, verb argument frames are very useful, as we will see.

12.2.2 Deverbal nouns

The meaning of deverbal nouns, i.e. nouns derived from verbs, can to a great part be under-

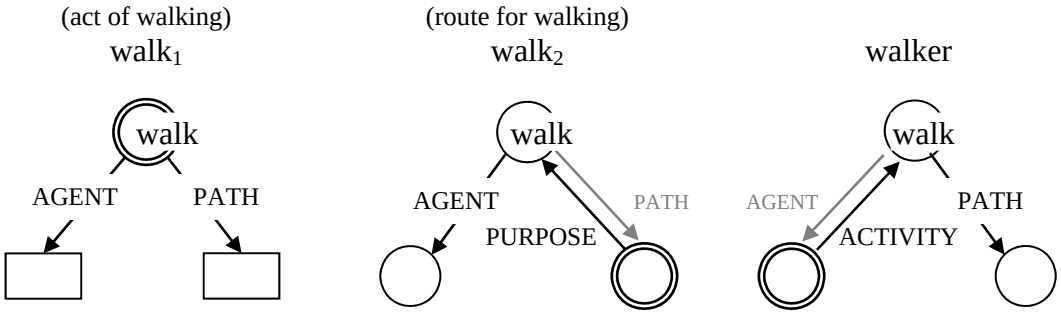


Figure 12.9 Frame graph for three nouns derived from the verb *walk*

stood as the result of simple operations on the argument frame of the underlying verb. Figure 12.9 shows three nouns derived from the verb *walk*. The verb concept has an AGENT attribute and a PATH attribute; the latter is syntactically not obligatory. It can be partly or completely specified by source, goal and/or path specifications like *from the station, to the post office, through the park*, respectively. The first variant, as in *I had a nice walk this morning*, refers to the event itself. The two original verb arguments are two potential relational arguments of the noun *walk*$_1$. Therefore they are depicted as rectangles. The argument frame of the noun is identical with the argument frame of verb *walk* (in one of its alternates). The principal difference between a verb concept and a noun concept – whatever it is – is not captured by the mere case frames.

The second variant *walk*$_2$ denotes a route for walking. Its referent is the path that is walked along. Thus the referential node is shifted from the event to the path. The frame contains not only a link from the 'walk' node to the referential node, but also a reverse link PURPOSE. This is owed to the meaning of *walk*$_2$: it is a path FOR walking. The attributes AGENT and PATH of the event node are not deleted. They belong to the concept of *walk*$_2$: a walk is the path of walking and there is no walking without walkers. However, neither the event node nor the agent node is a relational argument of the noun *walk*$_2$, since the reference of 'path' can be identified without determining somebody engaged in an act of walking on the path.

The concept ›walker‹ is formed from the verb concept by shifting the referential node to the AGENT of walking. Again, there is an inverse link from the 'walker' node back to the event node. The corresponding attribute can be added and labelled 'ACTIVITY': a 'walker' is someone engaged in an activity, their activity (a functional concept) is walking.[3]

In this way, frames can be used to analyze the meanings of certain types of word formation. We will see in the next section, that frame theory can not only model the meanings of certain types deverbal nouns, but also help us to understand the semantics of denominal verbs and nominal compounds.

12.3 Nouns and frames

Nouns have few if any relational arguments. Thus, the argument frames of nouns do not offer much of an access to noun concepts. It may well be the case that the concepts for complex things like humans and animals or cars and universities are, in themselves, very complex. In general, it is very hard to get at the internal components of noun meanings.

12.3.1 Metonymy

One way of getting at the components of noun meanings is to study metonymy. In 3.4.3.1, metonymy was introduced as shifting the reference of an expression to something that BELONGS to the original kind of referent. For example, metonymy applied to the concept ›university‹ may shift reference to the university campus, the university administration, the university staff, the university's student body, the university's course system, and so on. From the point of view of frame theory, these things belonging to the original referent are just the values of corresponding attributes: the campus is the value of the attribute CAMPUS of the university, and so on. Therefore we can infer from the possible metonymical shifts that the original concept contains certain attributes of the referent. In the case of the concept ›university‹ these include the attributes CAMPUS, ADMINISTRATION, STAFF, STUDENTS BODY and COURSE SYSTEM.

[3] The walker might be one who is engaged in walking in a particular situation, or habitually. This kind of difference cannot be modelled in the simple frames used here.

Using frames, we can characterize metonymy much more precisely: reference is shifted to the value of one of the original referent's attributes. This is, however, only a necessary, not a sufficient condition. Metonymy is not possible for every attribute of universities. For example, every university has a year of foundation, say 1869. But one cannot use the term *university* for referring metonymically to the year of its foundation, like in *Boston University was a year of considerable unrest*. In order to understand the restriction, let us first have a look at the university example. Figure 12.10 illustrates the effect of applying the metonymical shift from the institution to the campus metonymical to the concept ›university‹.

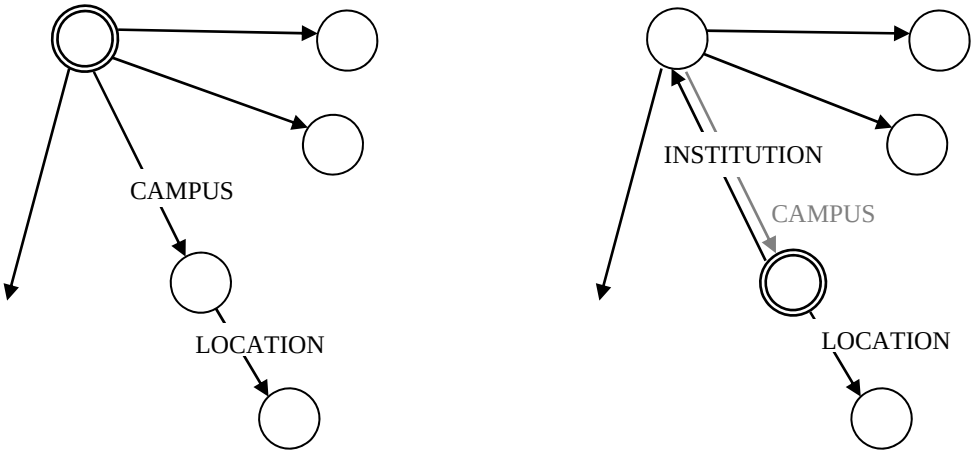


Figure 12.10 Metonymical shift ›university‹ to ›campus‹

The original frame on the left contains an attribute CAMPUS of the referent node, and many other nodes, only vaguely indicated. The value of the CAMPUS attribute, i.e. the campus of the university, has its own attributes, among them an attribute LOCATION which is responsible for the possibility to form sentences like *the university is in on a hill*. With the metonymical shift, the value of CAMPUS becomes the referent node. The new referent can be linked back to the original referent by an attribute which takes the university itself as its value. Such a functional concept does exist, although we do not have a specific functional noun for it; in the figure, I have simply dubbed the attribute INSTITUTION. It is a proper functional concept because, according to our notion of a campus, a campus will host exactly one university (or similar institution), whence there is a one-to-one correspondence between campuses and institutions with a campus.

The example shows that there is another necessary condition for metonymic shifts: the referent node can only be shifted to an element of the frame that is linked back to the referent node by an appropriate attribute. There must be a one-to-one correspondence between the original referents and referents resulting from the metonymic shift. This is in accordance with a general condition for metonymy: In metonymic use, the literal referent 'stands for' the metonymic referent: the university stands for its campus – and vice versa: if the campus is a location called, say, Ormond Hill, the name of the location can be metonymically used for the university with its campus there. This is not impossible if there is more than one campus for a university, or if a certain area hosts more than one university. In fact, if these conditions are not given, metonymy fails. For example, Tokyo University has two separate campuses, one at Komaba and one at Hongo. Thus, one cannot say, for example, (5a), because this would apply only to the Komaba campus. Conversely, (5a) would not refer to Tokyo University as a whole.

(5) a. Tokyo University lies close to Shibuya.

b. Hongo has entrance examinations tomorrow.

If you take a second look at the types of metonymy that were mentioned in 3.4.3 and listed in (10) in 3.5.2, you will realize that this condition is fulfilled in all cases. For example, the pars-pro-toto type metonymies (cf. *redneck*, *asshole*) shift reference to a part of the original referent; parts belong to a unique whole. The analogue holds for types like 'carrier for content' (*write a paper*), 'container for content' (*drink a bottle*), 'residence for government' (*Beijing reacted immediately*), 'clothing for wearer' (*blue helmets*), etc. In the case of *fluid* or *celebrity*, an instance of something having a property stands for the carrier: this instance has a unique carrier, and the carrier displays this unique instance.

Cognitive linguists like Lakoff consider metonymy (along with metaphor) a fundamental conceptual mechanism of cognition (cf. Lakoff 1987). Indeed, the mechanism of shifting the referent node in a frame and linking it back to the original referent node is not restricted to metonymical shifts. The examples of deverbal nouns analyzed in 12.2.2 are based on the same conceptual mechanism.

12.3.2 Affordances

We saw in 11.3 on levels of categorization that one crucial aspect of categorization is the manner in which we interact with members of a category. This holds in particular for categories of artefacts. Artefacts exist because people invented and produced them, and – except in the case of art – they did so in order to use them for certain practical purposes. The purpose for which an artefact is designed constrains its other characteristics such as its shape and size and the material it is made of. But, at the same time, a given purpose can be achieved in very different ways; just think of the practically unlimited ways in which chairs may be designed. What unites these exemplars of the general category of chairs is that they are made for sitting on them and therefore more or less sit-on-able. (Note that not everything sit-on-able is a chair, e.g. a sofa, a bike or a camel.) We may therefore assume that the types of activities for which an artefact is designed are included in the conceptual representation of the corresponding category: the frames for concepts like ›cup‹, ›bowl‹, ›vase‹ [4], ›hammer‹, ›car‹, ›saxophone‹ or ›T-shirt‹ have an attribute that specifies certain ways of interacting with this kind of object. Taking up a term from philosophy and generalizing it for our purposes, we will call these interactional properties of objects 'affordances': chairs have the affordance that they are for sitting on, a cup has the affordance of being for drinking from, a saxophone is for playing music on, a car for sitting in and driving from A to B. In the frame graphs, I will use the label 'FOR' for the affordance attribute. The affordance attribute links the referent to an activity; the activity carries its argument frame. One of the arguments is identified with the referent of the main frame; the corresponding role link is the inverse of the affordance link. Thus, an affordance attribute not only provides a link to an activity but also specifies the role that the frame referent plays in the activity. Figure 12.11 shows the frame for ›cup‹ with the drinking affordance. All other attributes of the cup, indicated by the little arrows pointing off the referent nodes are not elaborated. The cup fills the container role in the drinking activity.

The THEME and AGENT attributes provide conceptual links from the frame referent to a beverage and a drinking person. These links can be employed for the interpretation of possessive constructions such as *my cup* or *cup of tea*, which can be taken as ›cup speaker drinks

4 Recall the discussion of the Labov experiments in 11.4.2.

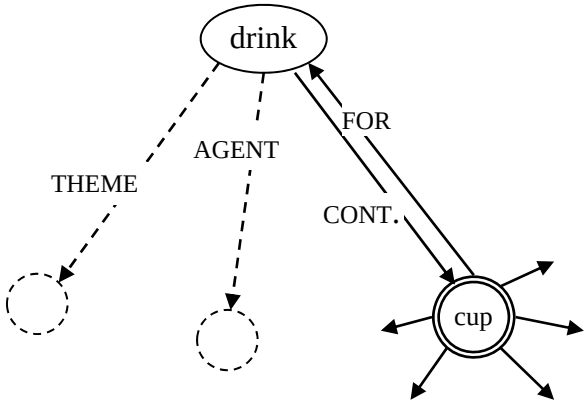


Figure 12.11 Frame for ›cup‹ with drinking affordance

from‹ and ›cup containing tea to drink‹. (Recall the discussion of the interpretation of possessive constructions with sortal nouns in 4.1.4: one needs some relation between the possessor and the referent for interpreting possessive constructions.)

There are concepts and categories at the superordinate level of categorization which are essentially reduced to a certain affordance specification, for example ›food‹, ›garment‹, ›footwear‹, ›vehicle‹, ›vessel‹, ›aircraft‹, ›musical instrument‹, etc.

12.3.3 Nominal compounds

Affordance attributes are a key to certain types of nominal compounds. Consider the case of *coffee cup*. In one of its meaning variants, *coffee* denotes a beverage. As such it has the affordance of playing the THEME role in a drinking activity. Since both parts of the compound *coffee cup* have a drinking-affordance, the two frames can be connected by unifying the drinking nodes in the two frames. Figure 12.12 shows the two frames of ›coffee‹ and ›cup‹ with their drinking affordances and indicates the unification of the two 'drink' nodes.

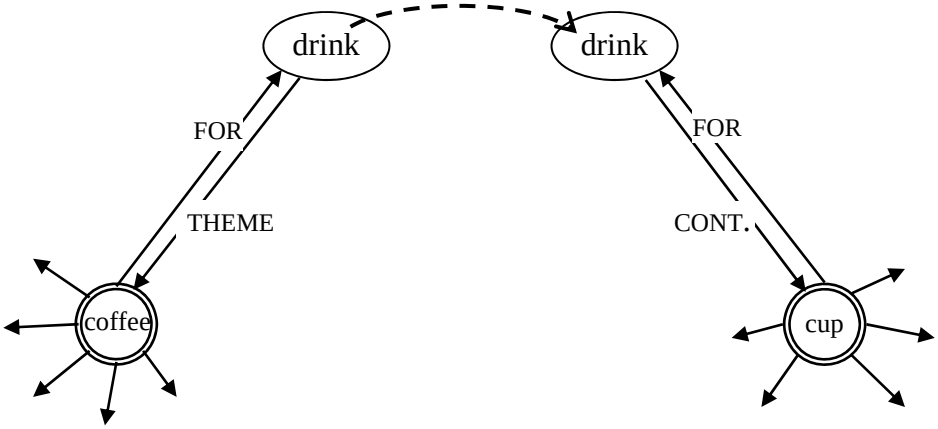


Figure 12.12 Unification of frames for ›coffee‹ and ›cup‹

The unification has the effect of integrating the 'coffee' node and the 'cup' node into the same ›drink‹ frame Figure 12.13. The referent node of the ›cup‹ frame becomes the referent node of the total frame, since *cup* is the head of the compound. The 'coffee' node loses its referent status (otherwise the frame would violate UR). This is in accordance with the fact that the compound *coffee cup*, unlike the syntactic combination *cup of coffee*, does not refer to any

coffee – a coffee cup is a coffee cup even when it is empty, or filled with water or another substance.

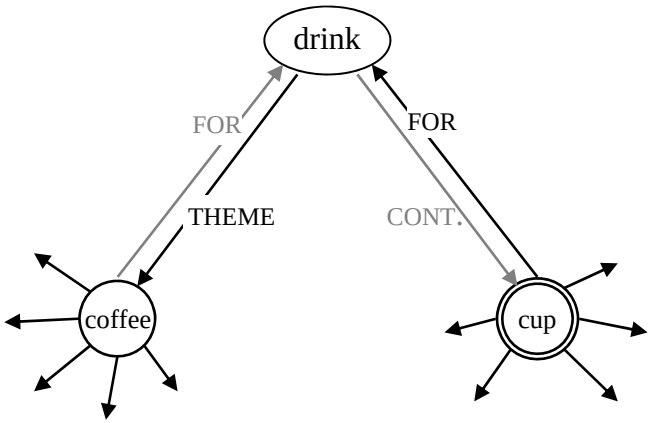


Figure 12.13 Frame for ›coffee cup‹

The example is representative of a very frequent conceptual pattern of compounding. It is not necessary that the linking activity frame is an affordance for both parts of the compound. For *book shop* we need not assume that one of the affordances of a book are to be sold in a shop. The ›shop‹ frame contains a selling (or buying) affordance in which the shop takes the role of the location of the event. For the regular interpretation of *book shop* we will unify the THEME argument of the ›selling‹ frame with the referent node of the ›book‹ frame. This is admissible in terms of the sortal restrictions of the THEME argument; but they require less than the affordance of being for sale. I would like to call this type of compounds **frame compounds**. There are three frequent types of compounds that can be straightforwardly described within the frame approach.

Value compounds. This type is represented by *plastic bag*, *company flat* or *park bench*. The modifier directly specifies the value of an attribute: the MATERIAL of the bag is plastic; the OWNER of the flat is the company; the LOCATION of the bench is a park. Thus the referent node of the modifier concept is unified with the value node of one of the attributes in the head frame (cf. Figure 12.14).

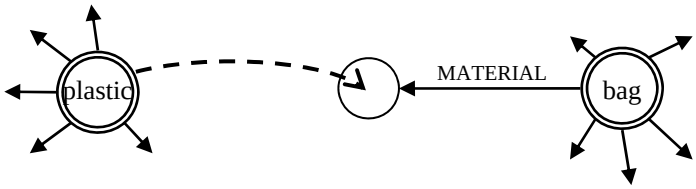


Figure 12.14 Unification of frames for ›plastic bag‹

Argument compounds. If the head noun is relational or functional, its frame provides for a possessor argument or other relational arguments. There are compounds which are interpret-

ed as the modifier specifying an argument of the head frame, e.g. *air pressure* ›pressure of (the) air‹, *oil price* ›price of oil‹ or *chicken leg* ›leg of a chicken‹. Figure 12.15 shows the way in which the frame for *air pressure* comes about.

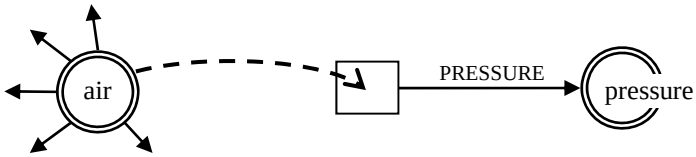


Figure 12.15 Unification of frames for ›air pressure‹

Synthetic compounds. So-called synthetic compounds are cases such as *piano player* or *bus driver*. The head is a deverbal noun which comes with the verb frame integrated into its frame (cf. the frame for *walker* in Figure 12.9). The modifier specifies another argument of the event; the unification mechanism is the same as with frame compounds (cf. Figure 12.12).

Reflection on the analysis of regular compounds. The examples illustrate that the frame approach to word meaning is able to account for central aspects of the semantics of regular compounds.

- The basic mechanism is unification. By means of unification the conceptual content of the modifier is added to the frame of the head and connected to the referent.
- The compound and the head share the same referent.
- The meaning of the head is contained in the meaning of the compound.
- Therefore, the compound is a hyponym of the head (cf. 8.2.1).
- Unification leads to a specific relation between the meaning of the head modifier and the meaning of the head (cf. 8.2.2).

12.4 Frames and composition

12.4.1 Composing a predication

Frames theory allows us to model elementary steps of composition. The basic mechanism is unification. Predicate expressions carry open argument nodes as the values of the role attributes. These open nodes are unified with the referential nodes of the frames for the arguments. This will be illustrated with the first example from chapter 5:

(6) Johnny sent money to a dubious company.

The frame for the verb *send* is an argument with the three attributes AGENT, THEME and RECIPIENT, like the frame in Figure 12.8. For ›company‹ we will just use an unanalyzed frame, i.e. a referent node with unspecified attributes. The frame for the proper name *Johnny* will be just the referent node with one attribute NAME that assigns the value *Johnny*. The adjective *dubious* requires a frame without a referential node (because adjectives do not have a referential argument). We will represent it as an open argument node with one attribute, in this case RELIABILITY, assigning the value 'low'. Figure 12.16 shows the ingredient frames for the sen-

tence and the unifications that bring everything together into one frame for the complex sentence predication. Since this is not a one-word frame, it preserves all referential nodes as such. We are thus able to tell from the frame what the referents are which the sentence relates to.

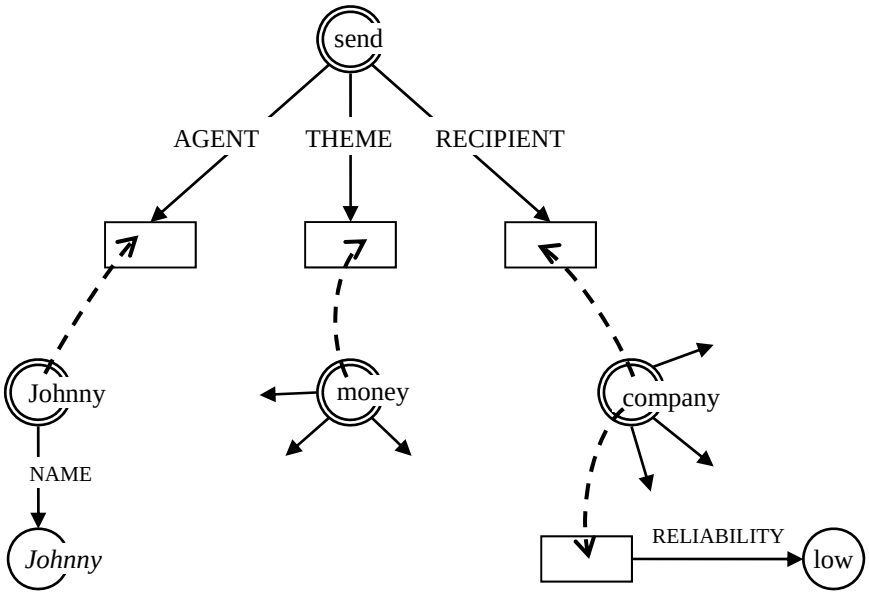


Figure 12.16 Unification of frames for ›Johnny sent money to a dubious company‹

The grammatical structure of the sentence indicates which nodes are to be unified in order to link all five frames to each other. The frame for the adjective is linked by unification of its argument node with the referent node of the ›company‹ frame because the adjective *dubious* is syntactically combined with the noun *company*. According to the linking rules of English, the subject of the sentence specifies the agent of the sending, the direct object, its theme and the *to*-PP the recipient. This leads to the unification of the referent nodes of the frames for ›Johnny‹, ›money‹ and ›company‹ with the respective argument nodes of the ›send‹ frame. Figure 12.17 shows the result.

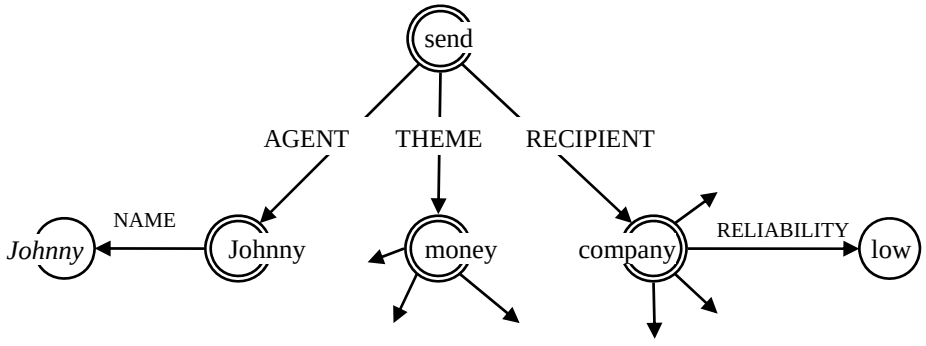


Figure 12.17 Frame for ›Johnny sent money to a dubious company‹

The frame for the whole sentence violates the UR condition on frames. UR only holds for lexical frames. In the frame of a sentence, the referents of the referring elements are all marked. Composition connects all conceptual information into one coherent whole. Thus, every piece of information is in the context of the rest of the sentence. It is this frame in which the meaning variants of the lexemes and grammatical forms occurring in the sentence are selected, and eventually shifted, to make everything fit (recall the discussion of the Principle of Consistent Interpretation in 3.4). In the case of our example, the combination of *dubious* with *company* rules out the meaning variant ›hesitating, doubting‹ because the company is very unlikely to be in that state. *Company* is taken in the ›commercial business‹ sense, required by its role as the recipient of sending; the meaning ›being with someone‹ (as in *I enjoyed his company*) is ruled out in the setting of sending.[5]

12.4.2 Open problems

The frames in Figure 12.16 and Figure 12.17 represent only the predicate-argument structure of the proposition, and this is even without the tense argument (recall 6.3.5, 6.4). Tense and aspect are not represented; this is connected to the fact that the situation structure is not represented in the verb frames. Similarly, the frames we used do not capture the determination of noun phrases: in the example, we would get the same frame if *money* or *a dubious company* were replaced by *the money* or *the dubious company*. The frames capture only the core of the verbal and the nominal onions (6.6.1, 4.5.5). All of the functional elements of the sentence are missing. This does not mean that representation of these elements is principally impossible in the frame approach; it just represents the present stage of the application of frame theory in semantics.

12.5 Frames and cognition

12.5.1 Frames vs. features

As a theory of concept and category representation, the frame approach is superior to the feature approach in three important respects. First, the frame approach employs explicit attributes which are left implicit in the feature approach. For example, the three features that make up the description of ›girl‹ in Table 9.3, [+HUMAN], [–ADULT], [–MALE], implicitly specify the values of three attributes:

(7)

[+HUMAN]	_____.SPECIES: human
[–ADULT]	_____.AGE: young
[–MALE]	_____.SEX: female

Thus, the features used in BFA are in fact fixed combinations of an attribute and one out of two possible values. It goes without saying that semantic analysis should be explicit about the notions actually employed. Barsalou cites empirical evidence that shows that humans actually use attributes for categorization rather than just feature lists (cf. Barsalou 1992b:25–29).

Second, BFA restricts the description to binary features. This is psychologically unmotivated. In fact there are very few attributes that admit only two values, SEX would be one. Given that visual perception plays a very important role in categorization, there is no reason whatsoever to exclude attributes such as COLOUR or SHAPE, which can take an unlimited number of values. Due to its restriction to binary features, BFA is unable to deal with these aspects

5 The meaning descriptions relate to the Oxford on-line British English dictionary, http://oxforddictionaries.com/, accessed 18 Sep 2012.

of objects. There is no feasible way of describing the shape of a pig or the colour of its skin by a combination of binary features. At best, values of non-binary attributes are just turned into so many different features, like [HUMAN], [ROUND], [GREEN], etc.

Third, BFA descriptions lack recursion; no information can be included about the values of the attributes of the referent. Recall the problem we encountered with a feature description of *bikini* in 9.3.2. If one wanted to include into the meaning description of *bikini* that the wearer is female, there is no way to do so by using the feature [–MALE] (one could only use an ad hoc feature [–WORN BY MALE PERSONS]. With the frame approach, this property of bikinis could be easily represented as: bikini.FOR:wear.WEARER:(wearer).SEX:female. The lack of recursion is an immediate consequence of the restriction to binary features: there is no information which one could reasonably add about the + or – value of a binary feature.

12.5.2 Frames vs. prototypes

Barsalou emphasizes that prototypes can be integrated into frame theory (Barsalou 1992a:161ff). Prototypical properties can be integrated into frames as default values for certain attributes; for example there might be a default entry for the SIZE value in the ›bird‹ frame. Also, one might add, certain prototype effects can be captured by constraints. Again relating to birds, the fact that most, but not all kinds of birds are able to fly can be captured by a constraint that links the ability to fly to the relative size of the wings of the bird and to its weight. Using a frame model for concept representation would also offer a possibility for coping with another question left unanswered by prototype theory: PT bases category membership on the degree of similarity to the prototype, but it does not say which aspects of the objects considered matter for the similarity judgement: shape? size? colour? affordance? (recall 11.2.9). Frame theory would be able to define the criterion of similarity in terms of the attributes involved.

12.6 Conclusion

The application of Barsalou's frame concept to semantics is a recent development. It offers possibilities for analysing word meanings in terms of attributes and the values they take. Superior to both the binary feature approach and prototype theory, it is the first explanation that promises applicability to the decomposition of all parts of speech as well as to the questions of semantic composition. It is also the first theory of representation which is, at the same time, formally more precise and explicit than its competitors and based on experimental cognitive research. As a framework for doing conceptual semantics, the theory is still in its early stages, but it is very promising, both as a perspective for the classical problems of semantics – lexical semantics (including the semantics of word formation), grammatical meaning and compositional semantics – and as a perspective for cognitive linguistics in general.

As far as compositional semantics is concerned, there is another framework incomparably further developed than what we have sketched above: Formal Semantics, to which an in-a-nutshell introduction is given in the next chapter. Formal Semantics, however, is an approach which does not aim at the cognitive level of meaning; in fact, the cognitive level is not included at all in that framework.

Further reading

Ungerer and Schmid (2006) contains a chapter about 'frames' and 'scripts' and their applications in cognitive semantics; the notion of a frame used there is similar, but not the same as the one used here. Kövecses (2006: ch. 5– 9) applies a very broad notion of frames to phenomena including metonymy and metaphor. Barsalou (1992b) gives an introduction into the notion of frames (as used here) and their applications; Barsalou (1992a, ch. 7) discusses frames in the general context of an introduction to cognitive psychology. On frames vs. feature lists and the relation of frames and prototype theory see Barsalou (1992a, 7.2).
There is a huge on-line resource of frames related to English words: the FrameNet site at www.icsi.berkeley.edu/framenet, initiated and supervised by Charles Fillmore. It contains a network of thousands of frames, in terms of core and non-core attributes and their relations to other frames. The network is permanently being extended and refined; it is a very valuable resource of lexical semantics – browse it!

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