

Lexical Meaning and Conceptual Representation

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Abstract

This note sketches a proposal for a general distinction between conceptual representation and semantic representation on the level of lexical items and discusses some of the theoretical implications of this distinction.

Lexical meaning of natural language expressions is formulated in terms of sets of inferences from "lexical sentences", i.e. minimal environments for the occurrence of a lexical expression. These inference sets are different, ex hypothesi, for all lexical expressions (entailing the assumption that there is no such thing as synonymy between lexical items).

The relevant inference sets that serve as meaning representations do not comprise more inferences than is required in order to keep the representation of one lexical item distinct from all others, and they are monotonic in the sense that they are not revisable.

Inference sets are considered as models for concepts, and accordingly meanings, at least formally, are concepts. Not every word meaning though corresponds to a natural concept. More often a word meaning will determine a class of concepts, each of which contains the inference set of the super-concepts as a subset. The additional inferences are contributed by the linguistic environment (in the simplest case via compositional semantics and the lexical meaning of other words), by the discourse context, or by background knowledge.

1 Words and Senses

Consider a dictionary representation of lexical meanings as in Figure 1¹. What is the rationale behind the identification of the 29 senses of *open*. Should it not perhaps be rather 30 or 40? And why would 10 not do, or 5, or just one? – The issue is not this particular entry and this particular dictionary², but the general case.

¹ I am grateful to the participants of the Symposium on Discourse and Lexical Meaning on 30th Nov-1st Dec, 1992 for comments and criticism. I also want to express my thanks to Peter Gerstl, who kindly read and commented upon an earlier version of this note.

² The extract is from Collins Cobuild English Language Dictionary, Collins, London and Glasgow, 1987. This dictionary has been chosen for the reason that word meaning is fundamentally represented in the form of inferences from lexical sentences, which is a format very much in line with the position taken in this paper.

<p>open /ɒpən/. opens, opening, opened. 1 If you open something such as a door, or if it opens, you change its position or unlock it so that air, light, things or people can pass through. <i>She opened the door with her key... The door opened.</i> + used as an adjective. <i>...the open window... The drawer slid open... He pushed open the front door.</i> • If an action opens the door or opens doors to something, it makes a situation possible or allows people to do something which was not possible before. <i>The country opened the door to imports... Use your contacts to open doors and meet the people who matter.</i></p>	<p>V-ERG I move ≠ close</p> <p>➤ ADJ CLASSIF ≠ closed</p> <p>➤ PER: VB AND N INFLECT</p>	<p>15 If you say that a person, idea, system, etc is open to criticism, blame, praise, etc you mean they are likely to receive it because of the qualities they possess or the effects they have had. <i>The critic is open to attack... Such a description is open to misunderstanding.</i></p>	<p>ADJ CLASSIF: PRED + to = susceptible</p>
<p>2 If you open a bottle, box, or other container, you remove or unfasten the lid, cork, or other device that keeps it closed. <i>Open the toolbox... I opened a can of beans.</i> + used as an adjective. <i>...an open packet of cigarettes... Boylan couldn't get the bottle open.</i></p>	<p>V+O</p> <p>➤ ADJ CLASSIF</p>	<p>16 When a shop, office, or public building opens or you open it, 16.1 its doors are unlocked, the people in it start working, and customers or clients can use it. <i>He sat outside, waiting for the bar to open... When does the library open?</i> + used as an adjective. <i>The firm kept its office open in Delhi.</i> • opening. <i>The Gallery is experimenting with evening opening.</i> • See also opening hours, opening time. 16.2 it starts operating for the first time. <i>They're opening an office in Birmingham... Philips opened up four new factories last year.</i></p>	<p>V-ERG ≠ close, shut</p> <p>➤ ADJ CLASSIF O N UNCOUNT</p> <p>V-ERG = set up</p>
<p>3 If you open a letter or parcel, you cut or tear the envelope, or remove its wrapping. <i>I'll open the mail after breakfast.</i> + used as an adjective. <i>...the open telegram on her desk... He tore open the envelope.</i> • See also open letter.</p>	<p>V+O</p> <p>➤ ADJ CLASSIF</p>	<p>17 If you open a building, public area, or institution you declare officially, usually at a public ceremony, that it is now ready to be used or to start operating. <i>When Parliament is opened, the Queen enters under Victoria Tower.</i> • opening. <i>...the opening of the new theatre.</i> + used as an adjective. <i>Lord Shawcross declared the hotel open.</i></p>	<p>V+O</p> <p>➤ N UNCOUNT ➤ ADJ CLASSIF: PRED</p>
<p>4 If you open a book, you move its covers apart in order to read or write on the pages inside. <i>Open the book at page 23.</i> + used as an adjective. <i>...the open Bible... She kept her diary open.</i> • If you describe someone as an open book, you mean that it is easy to know what they are thinking or why they are doing something.</p>	<p>V+O ≠ close, shut</p> <p>➤ ADJ CLASSIF ➤ PER: USED AS C</p>	<p>18 If you open a private place such as a house or garden, you specially allow people to visit it at certain times, usually because it is very old or connected with a famous person. <i>The Colonel opens his garden for the National Gardens scheme.</i> + used as an adjective. <i>...Hagley Hall is often open to the public at weekends.</i> • See also open day, open house.</p>	<p>V+O</p> <p>➤ ADJ CLASSIF: PRED</p>
<p>5 If you open your mouth, you move your lips and teeth apart, for example in order to eat, speak or express surprise or shock. <i>Open wide and point to the tooth that hurts.</i> + used as an adjective. <i>Angelica looked at me with her mouth open.</i> • See also open-mouthed.</p>	<p>V+O, OR V+A (wide) ≠ close, shut</p> <p>➤ ADJ CLASSIF ≠ closed</p>	<p>19 If a country opens its borders or frontiers, it starts to allow people and goods to pass freely between it and other countries. <i>The Japanese opened their borders to Western goods in 1853.</i></p>	<p>PER: VB INFLECTS</p>
<p>6 If you do not open your mouth on a particular occasion, you do not say anything: an informal use. <i>No man dared open his mouth, or out he went!... 'For goodness sake don't open your mouth.'</i></p>	<p>V-O</p> <p>= say a word</p>	<p>20 When a public event such as a conference, or an artistic event like a play or film opens, it begins to take place, be shown, or be performed for a limited period of time. <i>The trade union conference opened last week... We went on tour before opening in London in 'The Three Sisters.'</i> • opening, openings. <i>...the opening of 'Nicholas Nickleby' on Broadway.</i> • See also opening night.</p>	<p>V I start</p> <p>O N UNCOUNT + SUFFIN COUNT = first night</p>
<p>7 If you have or keep your ears open, 7.1 you are listening very hard to hear a noise. <i>Can you keep your ears open for the phone?</i> 7.2 you are paying great attention to what people say around you because you want to know some particular information.</p>	<p>PER: VB INFLECTS</p> <p>PER: VB INFLECTS</p>	<p>21 If a person or activity opens or opens a particular event, they start the event by being the first person to perform or the first activity to occur, when other people or activities will follow. <i>Driberg opened with a question on finance... Senator Denton opened the hearing by reminding us of our duty... Gooch opened the batting for England.</i></p>	<p>V OR V+O = commence</p>
<p>8 If you open your eyes, you move your eyelids upwards, for example when you wake up, so that you can see. • If you open your eyes wide, you are expressing surprise or shock. <i>She opened her eyes wide and stared at me.</i> • If you open your eyes or someone's eyes to something, you make yourself or them realize the truth about a situation, especially when the truth is unpleasant. <i>Now my eyes have been opened, I shall never trust him again.</i></p>	<p>V+O</p> <p>➤ PER: VB INFLECTS</p> <p>➤ PER: VB INFLECTS</p>	<p>22 If a military action opens or you open it, it begins. <i>The Allies opened a general offensive against them.</i></p>	<p>V-ERG I start</p>
<p>9 If you have or keep your eye or eyes open, 9.1 you are looking for something that you want to find, for example when it has been lost. 9.2 you are being very careful because there is a possibility of danger. <i>Keep your eyes open for trouble.</i></p>	<p>PER: VB INFLECTS</p> <p>PER: VB INFLECTS = watch out</p>	<p>23 If you open fire, you start shooting. <i>Police opened fire on a mob of rioters.</i></p>	<p>PER: VB INFLECTS</p>
<p>10 If you open your hand, you unfold your fingers so that the palm of your hand can be seen, usually in order to reveal what you have been hiding in it.</p>	<p>V-O</p> <p>= unclasp</p>	<p>24 If you open an account with a bank or a commercial organization, you begin to use their services, by giving them some money to look after or invest, or by buying goods from them on credit. <i>I'm opening an account to save up for a new car.</i></p>	<p>V+O I start</p>
<p>11 If you open your arms, you stretch them wide apart in front of you, for example when you are going to hug someone. • If you accept or welcome a person, situation, or idea with open arms, you accept or welcome them with a lot of pleasure and enthusiasm. <i>Our teaching degree is welcomed with open arms in many countries.</i></p>	<p>V+O</p> <p>= throw wide</p> <p>➤ PER: USED AS ANA = enthusiastically</p>	<p>25 If someone or something opens the way to a new state or situation, opens opportunities for it, etc, they allow it to develop by changing the circumstances, people's attitudes, etc. <i>Wealth opened new opportunities for education.</i></p>	<p>V+O = create</p>
<p>12 If you open your mind to new ideas, you become ready and willing to accept and to try and understand their good qualities and possible benefits. <i>Open your mind to some new thoughts.</i> • openness. <i>...his openness of mind on historical evidence.</i> + used as an adjective. <i>She tried to keep an open mind on such subjects.</i> to open your heart: see heart. • See also open-minded.</p>	<p>V-O</p> <p>O N UNCOUNT</p> <p>➤ I receptive ADJ CLASSIF I receptive</p>	<p>26 If you open something that is blocked or it opens, the obstruction is removed and you can pass through. <i>It took three days to clear the snow and open the road to traffic... The crowd opened and let us pass.</i> + used as an adjective. <i>They try to keep the Pass open all winter.</i></p>	<p>V-ERG</p> <p>≠ passable ≠ blocked ADJ CLASSIF</p>
<p>13 If you describe someone or their character as open, you mean they are honest and do not want or try to hide anything or to deceive anyone. <i>Judy had an open and trusting nature... an open friendly smile.</i> • openness. <i>...their relaxed openness.</i></p>	<p>ADJ QUALIT = candid, frank</p> <p>O N UNCOUNT</p>	<p>27 If a place opens to, into, or onto another place, 27.1 you can go straight from one to the other, for example through a door. <i>These rooms have doors opening directly to the garden.</i> 27.2 it gradually becomes larger or wider until you reach the second place. <i>The passage opened out into a cavern.</i></p>	<p>V+A = lead</p> <p>V+out I widen</p>
<p>14 If you are open to ideas, suggestions, etc, you are ready and willing to accept them and to try and understand their good qualities and possible benefits. <i>He was always open to ideas... We are open to suggestions.</i></p>	<p>ADJ QUALIT: PRED + to = receptive</p>	<p>28 When flowers open, they change from being buds and their petals spread out. <i>Roses opened and fell within the day.</i> + used as an adjective. <i>The small white flowers are open in May.</i></p>	<p>V = unfold</p> <p>➤ ADJ CLASSIF: USU PRED</p>
		<p>29 If you say the clouds, the heavens, or the skies open, you mean that it starts to pour with rain; a literary expression. <i>The clouds opened and there was a terrific thunderstorm.</i></p>	<p>PER: VB INFLECTS</p>

Figure 1

The empirical basis for the various word senses listed here are observable inferences from *lexical sentences* (cf. Schnelle [unpubl.], Kunze [this volume]), in this dictionary clearly represented in the format "If [lexical sentence containing the lexical item at issue] then [inferred consequence]". – However, and quite obviously, these inferences are not solely due

to the particular lexical sense of *open* that is at issue. On the one hand, there is considerable interaction between the lexical items in the lexical sentence itself. And on the other hand lexical sentences are of course abstracted from a discourse context in which they are actually used or in which they have their natural place, and the implicit knowledge about a natural contextualization of the sentence contributes to the inferences that we observe. Apart from this, there is, of course, considerable influence of all sorts of general world knowledge. The entry for sense 24 in Figure 1, e.g., reads more like a brief lesson on the most common types of accounts in British commerce than an analysis of any particular sense of *open*.

There is indeed no direct observational access to word meanings or word senses. What can be observed fairly directly though is *contextual concepts* (cf. Bosch 1985): the result of an interaction of lexical meanings, discourse, and background knowledge on a particular occasion of use. It is these contextual concepts, and not word meanings, that determine the observable inferences from lexical sentences. Standard tests for the identity of word meaning (as discussed e.g., in Zwicky and Sadock 1975), such as, in particular, conjunction reduction or VP ellipsis, in fact do not test for identity of meaning, but for identity of contextual concepts. They show whether or not on a particular occasion of use and under the particular perspective of the situation two things are viewed as *the same*, i.e., as falling under the same concept. But this is in no way a direct consequence of word meaning (cf. for more detailed argument Bosch 1983: 80ff).

There may be as many contextual concepts denoted by one word as there are (types of) contexts in which the word occurs. So contextual concepts are not the sort of thing one would want to list in a dictionary. If the lexicographer decides nonetheless that, for a popular dictionary, it is sensible to include factual information pertaining to typical contexts of use, rather than attempt a strict characterization of lexical meaning, then this is obviously a decision with no relevance for our current discussion – after all the aim of popular dictionaries is to offer helpful information to the human dictionary user.

But how do we get from the observable data, where meaning and world knowledge are mixed, to a characterization of word meanings? The considerable variety of contextual concepts that may attach to one and the same word in different contexts makes the job appear nearly unfeasible, and one may come to think, if one calls each of these interpretations, preliminarily fixed by a paraphrase (as in Fig.1), a *sense* of the word in question, that there is next to nothing in common to these senses. – And if one inquires into the mechanisms that seem to link the various senses, i.e., by means of which one would be able to derive one of these senses from another one, one may get the impression that these mechanisms would, when applied sufficiently often and in the right order, allow for the derivation of practically anything from anything.

Both lines of thought – looking for commonalities as well as looking for mechanisms that relate different senses – are guided by considerations of *similarity*. But similarity alone is not enough, because anything is similar to anything else in some respect. – What we need in addition is the notion of *contrast*.

When we look for the semantic commonalities between different (sets of) occurrences of one word in order to characterize its lexical meaning(s), we cannot be satisfied with a specification that is so general that it also covers occurrences of other words, unless these words are actually synonymous with the word we are concerned with. But true synonymy is a true exception.

Since we are not concerned here with relations of semantic equivalence between composite expressions, this leaves us with just two types of synonyms: one are pairs of a full expression and its abbreviated counterpart (such as *laboratory - lab*, *influenza - flue*) and the other are

pairs with elements from different vocabularies, different sub-languages, or just different languages that happen to co-exist in the linguistic behaviour of a population. Typical examples are pairs with one more popular and one more technical word, such as *smallpox - variola*, *poisonous - toxic*. In both types of cases we are dealing with exceptions, arguably even with diachronically instable cases, that should not play a central role for the theory of lexical semantics.

There is another important aspect to the role of lexical contrast for word meaning. If lexical contrast is seen as a crucial factor in the determination of lexical meaning then the notion of lexical meaning becomes closely tied to individual languages, because lexical contrast is of course a matter of a particular vocabulary. Hence it is *prima facie* unlikely that there are very many lexical meanings that are the same across language boundaries. And this fits precisely the conception of lexical meaning that we are after: a notion that is language specific, and is not a matter of general cognitive impact, as world knowledge, on the other hand, clearly is.

2 Lexical Meaning

Taking inferences of lexical sentences as our empirical basis and following the above considerations of similarity and contrast we arrive at the following notion of lexical meaning:

Assume one and the same lexical meaning for each w_i in a set W of occurrences of a word w if and only if

a characteristic set of entailments for all $w_i \in W$ can be specified that does not hold when a word, $w \neq w_i$, is substituted for w .

The lexical meaning of a word w that is realized in a set W of occurrences of w is given by the exactly those entailments that are common to all w_i in W .

For illustration let us apply these notions to the case of the intransitive verb *to open*. A first attempt that lets the verb *to open* refer to an event concept OPENING³ might look as follows:

- (1) $\lambda x [\exists e ((\text{OPENING}(e) \ \& \ \text{THEME}(e,x)) \vdash$
 $(\text{TRANSITION}(e)$
 $\quad \& \ \exists s_1 (\text{PRECEDING_STATE}(e,s_1)$
 $\quad \quad \& \ \text{CLOSED}(s_1)$
 $\quad \quad \quad \& \ \text{THEME}(s_1,x))$
 $\quad \& \ \exists s_2 (\text{RESULTING_STATE}(e,s_2)$
 $\quad \quad \& \ \neg \text{CLOSED}(s_2)$
 $\quad \quad \quad \& \ \text{THEME}(s_2,x)))]$

Apart from the concept names OPENING and CLOSED, this is no more than merely an instantiation of a general schema for a particular class of transition concepts. Note that (1) is not a meaning postulate: no word meanings are explicitly at issue here, but we are concerned with inferential relations among concepts.

If we want to formulate a meaning postulate for the same purpose, it would relate the English expression *opens* to the English expression *is closed* and could perhaps be formulated as follows:

³ cf. for the semantics of events Parsons (1990)

$$(1') \quad x \text{ opens at } t_0 \rightarrow \\
(x \text{ is closed} < t_0 \\
& \quad \neg x \text{ is closed} > t_0)$$

Here we are fixing logical relations between sentence forms that contain particular English expressions, assuming that all the rest is logical vocabulary. The less desirable property of meaning postulates for natural language expressions (which does not usually hold for expressions of formal languages) is that the natural language expressions themselves are not semantic constants, i.e., they are inferentially instable. Nothing can prevent us from reading *open* or *closed* in a different sense each time we apply the meaning postulate. And as long as the relations between the natural language expressions that are fixed in the meaning postulate remain unaffected by such re-interpretations the ambiguity remains unnoticed and the meaning postulate does not sufficiently constrain the interpretation of the expression in question; the effect being that contradictions may arise somewhere else in the system of meaning postulates. – This cannot happen for entailment rules given in terms of concepts; concepts by definition are inferentially stable (they are functions into the truth values).

The relation between words and concepts is a relation of reference. At the level of lexical entries it can be represented by lexical reference rules of the form

$$x \text{ opens: } \lambda x [\exists e (\text{OPENING}(e) \& \text{THEME}(e,x))]$$

where the concept $\lambda x [\exists e (\text{OPENING}(e) \& \text{THEME}(e,x))]$ need not (and usually will not) be a concept that is actually referred to by an occurrence of the verb *open* in any real context. What actual occurrences of the verb refer to are *contextual concepts* that result from the interaction of the *lexical concept* $\lambda x [\exists e (\text{OPENING}(e) \& \text{THEME}(e,x))]$ with various other sources of information, as was briefly mentioned above.

Next to intransitive *open* we must also take into account a syntactic variant in which an ergative subject (an agent or instrument) is added and the subject of intransitive *open* becomes the object of transitive *open*. Here we have a different lexical concept:

$$(2) \quad \lambda x \lambda y [\exists e (\text{OPENING}(e) \& \text{THEME}(e,x) \& \text{AGENT}(e,y)) \vdash \\
(\exists e_1 \exists e_2 (\text{CAUSE}(e_2,e_1) \\
& \quad \text{ACTION}(e_1) \\
& \quad \text{AGENT}(e_1,y) \\
& \quad \text{OPENING}(e_2) \\
& \quad \text{THEME}(e_2,x)))]$$

The last two lines, referring to the event that is being caused in a transitive opening, represent the intransitive opening concept from (1). Despite their different structure, thus the following entailment relation holds between sentences using the two concepts of opening, as in (1) and (2):

$$(3) \quad \lambda x \lambda y [(\exists e (\text{OPENING}(e) \& \text{THEME}(e,x) \& \text{AGENT}(e,y))) \vdash \\
(\exists e' (\text{OPENING}(e') \& \text{THEME}(e',x)))]$$

Before we continue discussing further meanings of *to open*, I want to attend to a worry that may easily be caused by the representations in (1) and (2). The worry is that our representations may be too general. They make no reference to the sort of thing that opens or is opened. But, at least at first blush, this is indeed relevant information: when it is said that

the shop has been opened we assume that we can walk in and buy things; when someone says that *a door has been opened*, we assume that we can pass through the door.

However, although such inferences are essential to natural language understanding, they are not entailed by what is said and hence are not a matter of meaning, but of factual knowledge (and hence only qualify as default assumptions) that may be inferred from the factual knowledge of the nature and use of shops and doors. The default character of these inferences can be demonstrated by the fact that they are easily overwritten in the following examples:

- (4) She opened the shop to let the cleaner in.
- (5) She opened the door and it turned out that it was hollow inside.

In (4) the assumption that the shop is open for business is certainly not part of what is being said explicitly or implicitly; and what (5) says rather seems to be that the inside of the door as a three-dimensional physical object is being made accessible, and nothing follows about the door's functional status, i.e., its allowing or prohibiting access to a room. Here secondary or non-focal aspects of doors and shops are activated (a shop is also a room and a door is also a three-dimensional physical object), which become available not through the meaning of the words but through factual knowledge about shops and doors. – The fact that world knowledge influences the interpretation in just these ways shows that the sort of object that opens or is opened is a relevant parameter for the inferences. However, nothing in these observations can be used as an argument for the assumption that we are concerned with different concepts OPENING or, for that matter, with different meanings of *to open*. On the contrary: the variation we observe is a variation in the concepts of SHOP and DOOR, and not in the concept of OPENING.

In addition, however, there is the intuition that doors are affected differently when they are opened in order to be inspected from the inside and when they are opened in order to gain access to a room. Perhaps this becomes even clearer when we take examples like *they opened the border* vs *they opened the room*. In the first case, a barrier or boundary is removed in order to allow access to a spatial region; in the second case a spatial region is made accessible without any mention of its boundaries or barriers. Since a border can hardly be regarded as a spatial region and a room is not easily regarded as a barrier or boundary, the latter examples nicely line up with the two readings of *open a door*. And since doors may be regarded either as boundaries or as physical objects with an enclosed space, the expression *open a door* has the ambiguity we have observed.

Still, this does not yet settle the issue whether or not we are concerned with two meanings of *open*. At first blush one may be inclined to think that there is no need for two meanings. If we take as basic the concept of opening a boundary, then it can be inferred (via a couple of axioms in common sense knowledge) that by opening a boundary the space that is closed off by the boundary is made accessible. Conversely, when it is said that a bounded space is opened, there is the implication that some obstacle or boundary is removed so that access to the space is made possible.

As far as the entire set of inferences from the two assertions is concerned, then, no distinction in meaning or concept seems required. However, one may reasonably insist that there should be a distinction between *what is actually said* and *what follows from it under ordinary circumstances*. The latter notion, however, makes implicit reference to the use of common sense or domain knowledge and hence goes beyond what could reasonably be part of meaning. And from this perspective one would prefer to have two different concepts of OPENING, one that specifies its theme as something of the sort BOUNDARY and one that has a theme of the sort BOUNDED_SPACE.

Some care must be taken at this point in order to avoid the incorrect generalization that whenever there is a different term denoting a particular argument of a concept, then we are in principle concerned with a different concept. If we were to make such an assumption and allow for a different concept or meaning every time there is a different expression in the place of x in x opens, then we will of course get many more "senses" of *open* than those listed in Fig.1. Even if we assume different concepts of OPENING x every time x denotes a different sort, this will not significantly improve the situation.

The point is that for some arguments we actually want to claim that the concept is different, while for other arguments we want to regard the variation as having no influence on the concept. But even if we draw the line for the concept OPENING, as suggested above, in such a way that arguments of the sort BOUNDARY must be distinguished from arguments of the sort BOUNDED_SPACE, and claim that variation within these sorts are unimportant for the concept of OPENING, then we are still forced to assume an ambiguity for a large number of argument expressions. For instance, as we already saw, a *door* may be opened as a boundary or as a bounded space. But do we actually want this kind of ambiguity?

We shall look into this question first, in the next section, before we proceed with our discussion of the the meanings of *open*.

3 Conceptual shift

The ambiguity of *door* that crops up in the expression *open the door* is related to what Bierwisch (1982) calls a *conceptual shift*, a mechanism he proposed in order to account for certain types of polysemy. He observed that a school may behave as as building, e.g., when we say that the school got a new roof; it may also behave like a process, e.g., when we say that it starts at 8.30; it may behave as an institution when we say that it was founded in nineteen-ten, or it may behave like a group of people when we say that the school went for an outing.

The word meaning, or lexical semantic representation (SEM), of the word *school* is the same for all these cases; in Bierwisch's formulation:

$$(6) \quad \text{SEM ("school")} = \lambda x [\text{PURPOSE (x, PROCESSES_OF_LEARNING_AND_TEACHING)}]$$

The conceptual shift is brought about by the application of certain functions that map SEM into a *contextual concept* (or, as Bierwisch calls it, an *utterance meaning*); in the case at hand these are the following functions:

- (7) a. $\lambda x [\text{INSTITUTION } x \ \& \ \text{SEM } x]$
- b. $\lambda x [\text{BUILDING } x \ \& \ \text{SEM } x]$
- c. $\lambda x [\text{PROCESS } x \ \& \ \text{SEM } x]$
- d. $\lambda x [\text{POPULATION } x \ \& \ \text{SEM } x]$

Applying (7a) to (6), e.g., yields the contextual concept

$$(8) \quad \lambda x [\text{INSTITUTION } x \ \& \ \text{PURPOSE (x, PROCESSES_OF_LEARNING_AND_TEACHING)}]$$

This proposal shows a way of keeping the linguistic meaning constant and accounting for the observation of polysemy on the conceptual level.

A more recent approach to similar polysemy phenomena, by Pustejovsky and Boguraev (1992), does not keep the levels of meaning and conceptual representation apart and does not

assume any shifting operations, but instead proposes more complex word meanings (or concepts) that may be modified in different aspects, depending on the type of modification and the context. Pustejovsky and Boguraev postulate what they call a *qualia structure* for nouns, which is supposed to define the essential attributes of the corresponding objects, events, or relations. For the noun *car* the qualia structure is given as follows (cf. Pustejovsky and Boguraev 1992):

$$(9) \quad \lambda x [\text{car}(x) \quad \wedge \text{Const}(x) = \{\text{body, engine, ...}\} \\ \wedge \text{Formal}(x) = \text{physobj}(x) \\ \wedge \text{Telic}(x) = \lambda y, e [\text{drive}'(x)(y)(e)] \\ \wedge \text{Agentive}(x) = \lambda y, e [\text{create}'(x)(y)(e)]]$$

where *Const* is the relation between the car and its constitutive parts, *Formal* gives a classification of cars, *Telic* gives the purpose and function of cars, and *Agentive* gives the type of origin of cars.

Now certain modifiers of the noun *car* are seen as applying only to a subset of these qualia; e.g. the adjective *fast* would typically lead to a modification of the *Telic* function, yielding the following representation for *fast car*:

$$(10) \quad \lambda x [\text{car}(x) \quad \wedge \text{Const}(x) = \{\text{body, engine, ...}\} \\ \wedge \text{Formal}(x) = \text{physobj}(x) \\ \wedge \text{Telic}(x) = \lambda y, e [\text{drive}'(x)(y)(e) \wedge \text{fast}(e)] \\ \wedge \text{Agentive}(x) = \lambda y, e [\text{create}'(x)(y)(e)]]$$

But not only cars can be said to be fast, we can also speak of a fast motorway. If the *Telic* function of *motorway* is given as

$$\text{Telic}(x) = \lambda x, e [\text{travel}(e, \text{cars}) \wedge \text{on}(e, x)]$$

then *fast motorway* would lead to the following representation:

$$\text{Telic}(x) = \lambda x, e [\text{travel}(e, \text{cars}) \wedge \text{on}(e, x) \wedge \text{fast}(e)]$$

Thus Pustejovsky and Boguraev are able to account for the polysemy of *fast* that is manifested in expressions like *fast car*, *fast typist*, *fast game*, *fast book*, *fast motorway*, *fast decision*, without postulating different lexical senses of *fast* like, perhaps, *moving quickly*, *performing some act quickly*, *doing something requiring a short space of time*, or *involving rapid motion*. – The interesting point here is that the apparent polysemy of the adjective *fast* actually turns on a difference in how *fast* combines with the representation of the noun it modifies (or on differences in these representations) and is not modelled by any differences in the lexical meaning of *fast*. Pustejovsky (1989) here speaks of "spreading the semantic load". This is – despite other important differences – the same type of account that we have used above in our discussion of *open*.

The major difference between the Bierwisch account and the one by Pustejovsky and Boguraev is not only that the latter does not distinguish systematically between meanings and concepts but that it does not have an equivalent of what we called *contextual concepts* (or Bierwisch's *utterance meanings*). This means that the representation of *car* that is modified by the adjective *fast* is exactly the same as the representation that is modified by adjectives like *blue*, *rusty*, *broken*, *expensive*, *new*, or *beautiful*. This involves the implicit assumption that

the concept of car that is involved in such modifications is the the same throughout. The markedness of sentences like (11) therefore must come as a surprise:

(11) Fred's car is new, fast, blue, broken, and expensive.

On an account that recognizes a distinction between word meanings and concepts and furthermore assumes that different contextual concepts may be generated from one meaning, such cases can be regarded as involving different contextual concepts or, intuitively speaking, different *views* or *conceptualizations*, of a car.

Let me rephrase and slightly modify Bierwisch's account by saying that conceptual shift moves a concept *C* into the domain of another concept, *C'*, i.e., subsumes *C* under *C'*. – This is just a way of phrasing what I hinted at above by the term *viewing an object in a particular way*. We may view a door as a boundary (thus subsuming the concept DOOR under the concept BOUNDARY), or we may view a door as a three-dimensional physical object and hence subsume the concept DOOR under the concept BOUNDED_SPACE (and, of course, we may also view a door in plenty of other ways, e.g., as a board and use it as a table top etc.). – Let us pursue this line of structuring the relations among concepts a little further and make use of standard techniques of knowledge representation that have developed in connection with so-called terminological logics or term subsumption languages (cf. e.g. Brachman 1979, Schmolze & Woods 1990).

The basis is that we represent a concept extensionally as a sort (i.e. a set) with a number of attributes. Sorts may have one or more super-sorts and sub-sorts. In principle, we are concerned here with a lattice structure. Within the lattice, a sort would typically inherit all of the attributes (though not necessarily their values) from all of its super-sorts. Sorts are said to be instantiated by objects (in the most general sense of the word) that are elements of the sorts and exemplify the attributes of the sort.

We can illustrate this kind of structure with the help of Bierwisch's example. Any instance of the sort school may be viewed from different angles: as a building, as a set of people or population, as a set of events or a process, or as an institution – and it certainly has other aspects as well.

One way of representing such views of an objects is by regarding each view as focussing on a particular attribute or set of attributes of the sort that is instantiated by the object. One would then assume attributes like *HAS_BUILDING*, *HAS_POPULATION*, *HAS_ACTIVITY*, etc. for the sort SCHOOL – in a sense reminiscent of Pustejovsky's qualia structure. However, these attributes each represent a different view of schools so that on this account the sort SCHOOL can hardly be taken as a model of a concept. A proper model of a concept could not just contain any old attribute that any instance of the sort might have under one or the other perspective, but could only represent a subset of such attributes, i.e., those attributes that are focussed on in the actual concept at issue. Merging different aspects of the instances of one sort into one concepts would get us into the same difficulty that we observed above for Pustejovsky and Boguraev and we could not explain the markedness of sentences like (12), which is a clear example of *zeugma* and no better than (11).

(12) The school needs a new roof and went for an excursion last week.

A solution for this difficulty is to re-interpret the nodes in a sort lattice in such a way that not a node on its own is regarded as model of a concept, but a node together with an upward

path⁴. The inheritance history is thus made explicit and although we have only one node SCHOOL, we may have four (or more) different concepts SCHOOL₁₋₄, depending on the different subsumption paths we mentioned: via INSTITUTION, ACTIVITY, BUILDING, or POPULATION. At the same time, since attributes are inherited along the subsumption paths, we get different sets of attributes for the sort SCHOOL_i that is a sub-sort of BUILDING and for the sort SCHOOL_j that is a sub-sort of POPULATION. We thus achieve a better division of labour between attributes and super-concepts and have an elegant and intuitively very appealing way of saying what it means that there may be different views or conceptualizations of an object or a class of objects seeing something as something of a particular kind just means to subsume it under a particular sort.

An important point about this proposal is that we are concerned with matters of conceptual relations in knowledge representation and not with meaning. Any change in knowledge, even when brought about ad hoc by the discourse context, can be reflected dynamically in an adjustment of the subsumption relations. There is no need to postulate different meanings when no more than a contextually motivated ad hoc classification of an object is at issue.

Thus, for instance, in a conversation of road builders the phrase *fast motorway* may well mean a motorway that was built quickly or, to take an even more exotic case, if two people are busy looking up the telephone numbers of all petrol stations along particular motorways, they may need more time for one motorway than for another and refer to a motorway that took them very little time as a *fast motorway*. – It surely cannot be the job of either meaning or of any permanent or re-usable knowledge representation to provide for cases of this kind. For this would mean that the very concept of a motorway would have to have attributes or aspects of some kind or other that allow for the generation of even these rather outlandish interpretations. – Nor would it seem sensible to try and find a borderline between which of these phenomena are "regular" and which require explicit contextual introduction. The approach that recommends itself is dynamic subsumption relations as they can be represented in the form of subsumption paths. At the same time, the basic sorts and subsumption relations required may be kept in regular sort lattices as a form of permanent knowledge representation which forms the input for the computation of ad hoc contextual concepts and their subsumption paths⁵.

Note that nothing changes in this approach with respect to the extensional view of sorts: sorts are still sets of objects and their attributes are properties of these objects.

4 Meanings of *to open*

Let us now return to our case of *to open*. Here we are concerned with a sort OPENING that is a sub-sort of the sort TRANSITION, which again is a sub-sort of EVENT. Each transition event has a *PRECEDING STATE* and a *RESULTING STATE* (which are attributes of the sort TRANSITION). So much is quite general properties of transition events.

OPENING events may be characterized in the most general way as a transitions between a state

⁴ This proposal supercedes a suggestion in Bosch (1991a), which also allowed for different concepts to be represented by one node, but did not make the different inheritance relations explicit and hence led into the same difficulty we saw above for the approach of Pustejovsky and Boguraev.

⁵ I believe that this approach of dynamic subsumption relations can be extended quite naturally to cover such types of systematic ambiguity as between generic and specific, count and mass, and more specific cases as they are discussed by Dölling (this volume) etc.. Cf. Bosch (in preparation).

in which there is a closed boundary and a state with the boundary open. Hence the theme must either be a boundary (have a view under which it is of the sort BOUNDARY) or an object that has a boundary (be of a sort that has the attribute *HAS_BOUNDARY*). This much would account for the concept of opening bottles, boxes, cupboards, rooms, or cars, all of which have a spatial aspect, i.e., may be viewed as sub-sorts of BOUNDED_SPACE and hence have the attribute *HAS_BOUNDARY*. Opening lids or doors as a way of opening boxes, cupboards, rooms, etc. means opening boundaries: lids and doors may be *viewed as* BOUNDARIES. – It does not seem possible, however, to find a concept that unites these two kinds of OPENING events. I can see no way of reading sentences of the form

(13) He opened the x and the y.

in such a way that x refers to a boundary and y to something that has a boundary but is not a boundary (or conversely). – If this observation is correct then we must specify our initial representation in (1) with respect to the sort of the theme and accordingly assume at least two different concepts of opening events (and, correspondingly, two different meanings of the verb *to open*), which are given by the two concepts under (i) and (ii) respectively.

(i) $\lambda x [\exists e ((\text{OPENING}(e) \ \& \ \text{THEME}(e,x) \ \& \ \text{BOUNDARY}(x)) \vdash$
 $(\text{TRANSITION}(e)$
 $\ \& \ \exists s_1 (\text{PRECEDING_STATE}(e,s_1)$
 $\ \ \ \ \& \ \text{CLOSED}(s_1)$
 $\ \ \ \ \& \ \text{THEME}(s_1,x))$
 $\ \& \ \exists s_2 (\text{RESULTING_STATE}(e,s_2)$
 $\ \ \ \ \& \ \neg \text{CLOSED}(s_2)$
 $\ \ \ \ \& \ \text{THEME}(s_2,x)))]$

(ii) $\lambda z [\exists e ((\text{OPENING}(e) \ \& \ \text{THEME}(e,z) \ \& \ \text{BOUNDED_SPACE}(z)) \vdash$
 $(\exists x (\text{BOUNDARY}(z,x)$
 $\ \ \ \ \& \ \text{TRANSITION}(e)$
 $\ \ \ \ \& \ \exists s_1 (\text{PRECEDING_STATE}(e,s_1)$
 $\ \ \ \ \ \ \ \ \& \ \text{CLOSED}(s_1)$
 $\ \ \ \ \ \ \ \ \& \ \text{THEME}(s_1,x))$
 $\ \ \ \ \& \ \exists s_2 (\text{RESULTING_STATE}(e,s_2)$
 $\ \ \ \ \ \ \ \ \& \ \neg \text{CLOSED}(s_2)$
 $\ \ \ \ \ \ \ \ \& \ \text{THEME}(s_2,x)))]$

The TRANSITION in both concepts is the same: a closed boundary changes to an open boundary; only the theme of the OPENING is different. – Of course, we do not get different meanings of *to open* for each different theme in the OPENING concept. A difference in meaning is postulated only when no common set of entailments can be found that is distinct from the entailment sets for other words that could occur in the same syntactic frame (cf. above, Section 2). Since this is the case for the uses of *to open* with the two types of theme above, we assume two different meanings of *to open*. Further differentiations of the above two OPENING concepts by different types of boundaries or bounded spaces result from the interaction of these lexical meanings with other forms of knowledge and are not themselves lexical concepts or meanings, but are contextual concepts.

In addition to (i) and (ii) we need the transitive equivalents of these concepts: someone or something opening a BOUNDARY or a BOUNDED_SPACE, which adds an agent to the above concepts, an additional event (an action of the agent), and the notion that this action causes the OPENING. The last two or three lines of (ii) and (iv) respectively expand into the representations given above under (i) and (ii).

(iii) $\lambda x \lambda y [\exists e (\text{OPENING}(e) \ \& \ \text{THEME}(e,x) \ \& \ \text{AGENT}(e,y) \ \& \ \text{BOUNDARY}(x)) \ \vdash$
 $(\exists e_1 \exists e_2 (\text{CAUSE}(e_2, e_1)$
 $\ \& \ \text{ACTION}(e_1)$
 $\ \ \ \ \ \& \ \text{AGENT}(e_1, y)$
 $\ \ \ \ \ \& \ \text{OPENING}(e_2)$
 $\ \ \ \ \ \& \ \text{THEME}(e_2, x)))]$

(iv) $\lambda z \lambda y [\exists e (\text{OPENING}(e) \ \& \ \text{THEME}(e,z) \ \& \ \text{AGENT}(e,y) \ \& \ \text{BOUNDED_SPACE}(z)) \ \vdash$
 $(\exists e_1 \exists e_2 (\text{CAUSE}(e_2, e_1)$
 $\ \& \ \text{ACTION}(e_1)$
 $\ \ \ \ \ \& \ \text{AGENT}(e_1, y)$
 $\ \ \ \ \ \& \ \text{OPENING}(e_2)$
 $\ \ \ \ \ \& \ (\exists x (\text{BOUNDARY}(z, x)$
 $\ \ \ \ \ \ \ \ \ \ \ \& \ \text{THEME}(e_2, x)))]$

These four concepts cover most of the "senses" 1 to 19, and 24-29 in Fig. 1 (with the exception of 7, 9, and 13-15, which are not verb senses) – the additional distinctions drawn within this set are, according to the approach taken here, not due to differences in meaning, but derive from the interaction of meaning with factual knowledge.

What (i-iv) do not cover is the "senses" 20-23, and the corresponding aspects of the "senses" 16 and 17. Here we are not concerned with transitions but with the start of one or the other activity, i.e., the theme here is something that can be viewed as of the sort ACTIVITY. The corresponding concept can be formulated as follows:

(v) $\lambda x \lambda y [(\exists e (\text{OPENING}(e) \ \& \ \text{THEME}(e,x) \ \& \ \text{AGENT}(e,y) \ \& \ \text{ACTIVITY}(x)) \ \vdash$
 $(\exists e_1 \exists e_2 (\text{CAUSE}(e_2, e_1)$
 $\ \ \ \ \ \& \ \text{ACTION}(e_1)$
 $\ \ \ \ \ \ \ \ \ \ \ \& \ \text{AGENT}(e_1, y)$
 $\ \ \ \ \ \ \ \ \ \ \ \& \ \text{START}(e_2)$
 $\ \ \ \ \ \ \ \ \ \ \ \& \ \text{THEME}(e_2, x)))]$

The distinction between the start-of-activity sense of *open* and the transition senses is supported also by the distributional behaviour of *to open*. First of all, the ergativity which we can observe for the transition senses is missing for the start-of-activity sense, cf.

- (14) a. Fred opened the door.
b. The door opened.
- (15) a. She opened her speech.
b. *Her speech opened.

- (16) a. She opened the discussion.
 b. *The discussion opened.
- (17) a. The guards opened fire.
 b. *(The) fire opened.

Furthermore, the result of opening an activity cannot be described by the adjective *open*, cf.

- (18) a. Fred opened the door.
 b. The door was open.
- (19) a. The door opened.
 b. The door was open.
- (20) a. She opened her speech.
 b. *Her speech was open.
- (21) a. She opened the discussion.
 b. *The discussion was open.
- (22) a. The guards opened fire.
 b. *(The) fire was open.

In these occurrences of *to open* in the non-ergative meaning, *opening x* is not viewed as a transition, but as an action of starting an activity, i.e., a discussion, shooting, a speech. According to our meaning specifications for intransitive *open*, the theme must be something that can be viewed as either a boundary or a bounded space. Since speeches, discussions, and gunfire don't easily fit such a classification, the (b)-sentence in (15)-(17) are heavily marked and probably produce more puzzlement than understanding. Whether the asterisks are actually justified, I do not know.

Although we have not discussed the adjective *open* in this paper and hence should be careful venturing any independent hypothesis on the sort of thing that can be modified by this adjective, we can still use the evidence from the sentences (18)-(22) in order to support the preceding point, i.e., in order to show that meaning (v) that underlies (20)-(22) behaves differently from meanings (i)-(iv) that underlie (18) and (19).

Some occurrences are ambiguous between meaning (v) and one of the others; e.g., *opening a shop* may mean: starting shop activities⁶ or opening the shop door. In the latter case it's a straightforward transition, in the former the start of an activity. The ambiguity comes about because the sort SHOP to which the noun *shop* refers may be viewed as a node on a path on which, somewhere higher up, we find the sort BOUNDED_SPACE with the attribute HAS_BOUNDARY, or it may be located on a path on which there is the super-sort ACTIVITY. In either case we are concerned with a different concept of a shop and, accordingly, a different concept of opening.

⁶ A further reading of *opening a shop*, of course, is starting a business. I regard this as a generic variant of the start-of-activities sense discussed, but since the generic-specific distinction is not figuring elsewhere in this paper, I do not want to go into the point any further; but cf. Bosch (in preparation).

Conclusions?

None at the moment. At least nothing over and above what's actually been said above. I'd rather have some feedback and discussion.

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