

Meanings and Contextual Concepts

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Abstract

This paper proposes a division of labour between lexical meanings and conceptual representations with respect to the job of accounting for semantic properties of linguistic utterances. The corresponding narrow definition of lexical meaning that is put forward keeps lexical meanings rather attenuate, language specific, and strictly separate from encyclopaedic knowledge, while a large part of the burden of explanation is shifted to conceptual structures that are not in any sense specifically linguistic in nature. The approach is illustrated with an analysis of the semantics of the English verb *to open*.

1 Introduction

In the modelling of natural language understanding it is widely assumed that there is some level of representation that shows the *content* of the utterance or text¹. An important requirement for this level of representation is that it be *inferentially stable*: these representations, unlike linguistic expressions, must behave like logical constants under the usual inferential operations. This requirement becomes particularly important if next to, or in interaction with, linguistic analysis also inferential operations play a role in our model of natural language understanding.

Major obstacles for satisfying this requirement are *referential indexicality* and what may be dubbed *conceptual indexicality*. By referential indexicality I mean what is usually meant, i.e., the dependence of the reference of a linguistic expression on situational and contextual parameters as we find it typically with indexical expressions, like *I*, *here*, or *now*. By conceptual indexicality I understand

¹ This paper is a thoroughly revised version of a draft that was (pre)published as Bosch 1993. I have lectured on topics from this paper on a number of occasions, including the conference on *Linguistic and Conceptual Representation*, Antwerp, 26-28.11.92, the *International Summerschool for Language, Logic and Information*, Lisbon, 19.8.1993, a symposium of the SFB 340 *Between Syntax, Semantics, and Logic* in Stuttgart/Tübingen, 4.-8.10.1993, the Verbmobil project workshop on *Lexical Semantics*, 7.4.94 at TU Berlin, a joint workshop of the Max Planck Project Group on Structural Grammar and the IBM Institute for Logic and Linguistics in Berlin on 22.5.94, and as an introduction to a panel discussion at the *Fourth International Conference on Principles of Knowledge Representation and Reasoning*, KR'94, Bonn, 24-27.5.94. I wish to thank everyone who has commented on these ideas on the various occasions.

corresponding phenomena in lexical semantics, such as the fact that the adjective *white* does not seem to designate the same concept in *white wine*, *white hair*, *white chocolate*, or *white coffee*, as well as cases of the kind Hilary Putnam (1975:215ff) discussed as cases of indexicality of kind terms. Such cases drive a point home of which most semanticists have been aware for a long time, but which one often tends to ignore because of the awkward complications they entail: concepts as well as referents are the product of an interaction of several cognitive processes and are only in part determined by linguistic parameters.

Take the example of the adjective *white*: the meaning of this adjective alone cannot tell us the colour of white wine, white coffee, white hair, etc., and hence it cannot give us the conditions under which wine, coffee, or hair are truthfully called "white". In other words: the *meaning* of this adjective is something different from the relevant concepts of whiteness. Only in interaction with our knowledge of wine, coffee, and hair can we determine the various concepts required: Speaking of *white* coffee means to distinguish it from *black* coffee: all that is said is that there is milk or cream (or a substitute of one of the two) in the coffee, never mind the actual colour, which is more likely to be some shade of brown than anything anywhere near white. - The derivation of this concept of WHITE COFFEE² cannot be a compositional process that operates only on the meanings or intensions of *white* and *coffee*. If that were the case, we would have to assume a very large number of different - and possibly unrelated - meanings for the adjective *white*, just in order to account for the different properties that the adjective attributes to things in various uses. Instead we had better assume that the composite concept WHITE COFFEE contains more information than we may sensibly expect from meanings or intensions of the words *white* and *coffee*. In particular, it contains information about ways of serving coffee in a particular culture - which should not be part of lexical meaning, but is better regarded as a matter of speakers' experience in a particular (in the case at hand, socially fixed) environment, context, or situation. In brief, we get a kind of dependency on context and situation that is similar to what we know from indexical reference. And also here - as well as in the case of indexical reference - we are confronted with a set of parameters that is rather difficult to structure.

Since there is no way of eliminating indexicality in general (cf. Bosch 1982, 1985), this paper defends the introduction of a level of indexical, or context-dependent, representations that are *inferentially stable relative to the intended context*. These representations I call *contextual concepts* (for short: CCs). A crucial task that results from the introduction of these representations is that they be related to persistent, i.e., context-independent, lexical and conceptual representations.

2 Lexical Meanings and Contextual Concepts

2.1 Contextual Concepts

Let me first explain what I mean by contextual concepts (CCs). CCs are, first of all, concepts, and hence truth functions. Whereas proper concepts, at least in the traditional Fregean conception, are completely defined, i.e. defined for all possible arguments, CCs need only be defined for the actual arguments in their actual context. So the idea is that a predicate expression or functor refers in each context of use to a particular CC and that this concept is completely defined for that context. This means that CCs are inferentially stable within their context. For each application of a contextual

² Names of concepts are typographically distinguished in this paper by small capitals.

concept F to an argument x in the context c we have the same set of entailments Ψ : $\forall x_c (Fx_c \vdash \Psi)$, so that a CC is in fact equivalent to a set of entailments.

Proper concepts, or intensions, must fulfil the stronger requirement that they have the same entailments for all possible arguments of a particular type. If a concept, G , is defined for all arguments of type t there must be the same set Ψ of entailments for all such arguments: $\forall x_t (Gx_t \vdash \Psi)$. - Obviously, the form of the requirement is the same as for CCs. The difference is that CCs do not require a relativization to types, but are satisfied with a relation to arbitrary contextual sets of arguments and thus allow any typing of their arguments to remain implicit. This is a decisive advantage, because it allows us to build up ad-hoc CCs that are concepts only by virtue of context-specific knowledge.

Thus the dependency of CCs on a particular context distinguishes them from proper concepts or intensions. The latter are fixed for all possible worlds and all situations and contexts and hence must be independent from any contingencies of world knowledge. CCs, however, may incorporate situation and context specific world knowledge.

The linguistic motivation for assuming CCs comes from the investigation of conditions of identity in VP anaphora. While early transformational studies of VP anaphora would assume identity in Deep Structure, or Meaning, between the predicates of the conjoined sentences in $NP_1+VP+and_so_do+NP_2$ constructions, (1) demonstrates that this cannot be correct (cf. Bosch 1985).

(1) *Andy wants to talk to her₁, and so does Bert.*

When we ask what it is that Andy and Bert must have in common for (1) to be true, we see that they not only both must be wanting to talk to woman, but to the *same* woman. The referential interpretation of the pronoun *her*, ($REF(her_1)$), is part of the identity of the predicate.

(2) $\lambda x (x \text{ wants to talk to } REF(her_1))$

And since the reference of a constituent expression cannot sensibly be taken as part of an expression's meaning, it can't be the meaning of *wants to talk to her* that is anaphorically resumed by the anaphor *so does*, but we need another kind of entity for this purpose. This entity is the contextual interpretation, or *contextual concept*, to which the expression *wants to talk to her* refers in the context at hand. Part of the truth conditions for this concept is that it contains the correct reference to a particular person. So what is predicated of Andy in (1) is that he satisfies the concept given under (2).

But the point is not just *referential* interpretations. Cf. (3) as a continuation of (1):

(3) *Andy has no time on Wednesdays, nor has Bert.*

Here the interpretation requires identical concepts of HAVING NO TIME ON WEDNESDAYS for both Andy and Bert. The criteria for the identity of these concepts, however, cannot be derived simply from whatever meaning may be assigned to the VP *has no time on Wednesdays*, but they are influenced by the context fixed by the preceding discourse, i.e. sentence (2) and, possibly, other sentences preceding (2) plus other relevant information about the context or situation.

So, first of all, *has no time on Wednesdays* is interpreted as relating to the purpose of talking to the woman referred to in (2), where the wider context, including background knowledge, may tell us that the woman in question is applying for a job in Andy's and Bert's firm and that job interviews in this

firm take at least one hour. Furthermore, it is certainly not meant to be understood for all Wednesdays - not even all those within the intersection of the remaining life spans of Andy, Bert, and the woman in question - but presumably just for an implicitly assumed period of time. Also, having time or having no time for something always boils down to priorities people have, and these priorities may be different for Andy and Bert, except that for both of them the priority for talking to the woman referred to is too low compared to other plans they have. - Although there is little or no room for all this in the meaning of the expression *has no time on Wednesdays*, most of this information is actually used in the understanding of (3) in the assumed context and determines what property Andy and Bert, according to the statement made by (3), have in common.

CCs are thus very closely tied up with observations of linguistic behaviour in real situations: *having no time to talk to her* means, in the situation at hand, more or less what speakers intend to express. Speakers need not have any explicit knowledge of lexical meanings or compositional semantics, and neither is open to introspection. But speakers do know (permitting a little idealization) what they want to say, i.e., they know what CCs they want to use. CCs are directly open to his introspection and speakers can usually paraphrase what they mean and can, in principle, list the inferences they would like to be drawn from what they say. - CCs are very close to empirical observation, while meanings are much more theoretical notions that are linked to observation only indirectly.

It is thus empirically fairly easy to determine the CC that an expression is used to refer to in a particular context. - But in order to explain natural language understanding, our task is to reconstruct the processes, at least in abstract, by which speakers and listeners arrive at CCs with the help of their linguistic competence. And this means that we have to find a way of generating CCs from persistent (context-independent) linguistic knowledge, conceptual knowledge, and whatever situational and contextual knowledge may be available.

2.2 *CCs can't be lexical meanings*

A simple sketch of the mapping from lexical expressions to concepts is provided by Frege (e.g. Frege 1969). He assumed that a predicate expression, in virtue of its meaning (*Sinn*), refers to (*hat als Bedeutung*) a concept (*Begriff*) where a concept is a straightforward truth function.

The model was simplified by Carnap in the sense that he correlated a predicate expression directly with an *intension* (which he regarded as a concept or truth function) and took the intension to be the meaning of the predicate expression. This notion was challenged only in the Seventies, most prominently by Stalnaker (1976), Kaplan (1978), and Lewis (1981). The observation central to their work is the fact that indexical expressions make the truth of a declarative sentence depend on the context of utterance, and that this kind of parameter cannot sensibly be regarded as of the same sort as the dependence on the state of the world with respect to which the sentence is evaluated. Lewis (1981) distinguished the *theory of indexicality* from what he called the *theory of contingency*. What a speaker expresses by uttering a declarative sentence in a particular context is a proposition and it is this proposition that is then evaluated with respect to various possible worlds, or, if you prefer, to various states of the world.

This approach comes close to Frege's ideas again in allowing the semantic interpretation of a sentence (i.e. the proposition expressed) not only to depend on the meanings of words in the sentence and their mode of composition, but also on other, contextual or situational, influences that are not syntactically explicit. The prime case motivating this notion of context dependence was the case of indexical

expressions, whose contribution to the truth conditions of sentences is a matter of their reference in the utterance context. - The point in the present paper (and arguably already in Frege) is that not only the interpretation of indexical expressions is context dependent in this way, but in principle the interpretation of all lexical expressions.

Hence the notion that the observable contextual variation in the inferential behaviour of lexical items must be modelled by ambiguity in the lexicon does not look like a plausible general principle. Modelling variation in inferential behaviour by means of lexical ambiguity is only sometimes correct. Using the device of lexical ambiguity too generously has undesirable consequences: First, the dictionary becomes very large (in theory infinitely large) unmanageable for realistic applications. Second, the corresponding disambiguation problem becomes in theory untractable and, again, unmanageable for realistic applications.

Supposing we have empirically established a number of inference sets that are correlated with a particular lexical item in various contexts, i.e., a number of contextual concepts, CC1,...,CC5, then the natural choice in a Carnap model is the assumption of one linguistic meaning for each CC, as in Figure 1, and accordingly, a sheer explosion of the lexicon as more contextual variation is observed. The Frege model, however, allows us to view linguistic meaning as a function that yields different CCs, depending on the context, cf. Figure 2.

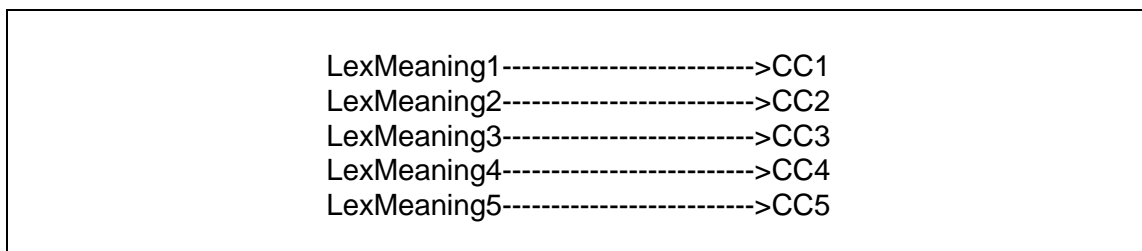


Figure 1

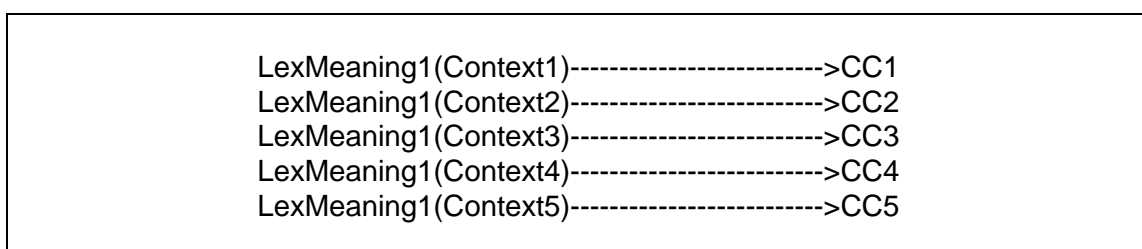


Figure 2

In empirical work, however, we cannot start out from lexical meanings, but have to reconstruct lexical meanings on the basis of our observations and hypotheses about inference sets (CCs) and related contextual parameters. - And if the lexical meaning of an expression is a function that yields a CC for a context (or possibly a class of CCs if the context is not sufficiently narrowly specified), then our enterprise is the reconstruction of a function on the basis of a (partial) table of values. In other words, there may be many solutions that are equally correct for the set of values available. - This is just another formulation of Quine's thesis of the *indeterminacy of meaning* (Quine 1960). I am not

particularly worried by this problem in the present context though. As things stand, we are not exactly threatened by the problem of having to choose between a multiplicity of solutions, but one solution that works correctly for all the data we know should be quite sufficient to make us happy.

Tackling this task practically, we need not start from zero, i.e., from the observation of linguistic behaviour, but we can make use of the results of lexicographical work. This may give us hypothetical descriptions of lexical meanings of the kind found in Figure 3. - But what is the rationale behind the identification of the 29 senses of *open* that we find there? Should it not perhaps be rather 30 or 40, or, perhaps 758? And why would 10 not do, or 5, or just one ? - The issue is not this particular entry and this particular dictionary³, but we want to understand the general case.

The empirical basis for the various word senses listed here are observable inferences from *lexical sentences* (cf. Schnelle, unpubl.), in this dictionary clearly represented in the format "*If* [lexical sentence containing the lexical item at issue] *then* [inferred consequence]". - However 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 encyclopaedic knowledge. The entry for Sense 24 in Figure 3, 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*, and Sense 3 looks like Lesson 1 of a course on elementary office skills.

From our discussion so far it would be clear that these lexical specifications are not what theoretical linguists call lexical meaning, at any rate, they are not what I mean by lexical meaning in this paper. It seems rather that the lexical specifications we find in Figure 3, or, for that matter, in most real life dictionaries, describe each *a class of CCs*. And since there may be as many CCs denoted by one word as there are types of contexts in which the word occurs (namely as many as you please), CCs are not the sort of thing the theoretical linguist 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 information to the dictionary user which can be helpful, one way or the other, in identifying the contribution of a lexical item to the understanding of actual utterances. And for this purpose no distinction between world knowledge and meaning is required.

But how do we get from the observable data - in real life, or compiled in a popular dictionary - where meaning and world knowledge are merrily mixed, to a characterization of lexical meanings? The considerable variety of CCs 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 that are preliminarily fixed by a paraphrase in the dictionary (as in Fig.3), 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

³The 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 /ə'pən/, 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... 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></i></p>	<p>V-ERG I MOVE V CLOSE + ADJ CLASSIF + CLOSE + PER: VS AND N REFLECT</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 PRES: + 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... used as an adjective. <i>...an open packet of cigarettes... Boylan couldn't get the bottle open.</i></i></p>	<p>V + O + ADJ CLASSIF</p>	<p>16 When a shop, office, or public building opens or you open it, 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? + used as an adjective. <i>...The firm kept its office open in Delhi. ... 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... Phillips opened up four new factories last year.</i></i></i></p>	<p>V-ERG + CLOSE, SHUT + ADJ CLASSIF + N UNCOUNT 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... used as an adjective. <i>...the open telegram on her desk... He tore open the envelope.</i> See also open letter.</i></p>	<p>V + O + 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. ... opening. <i>... the opening of the new theatre. + used as an adjective. <i>... Lord Shawcross declared the hotel open.</i></i></i></p>	<p>V + O + N UNCOUNT + ADJ CLASSIF PRES</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... 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.</i></p>	<p>V + O + 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. + used as an adjective. <i>... Hagley Hall is often open to the public at weekends.</i> See also open day, open house.</i></p>	<p>V + O + ADJ CLASSIF PRES</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... + used as an adjective. <i>... Angelica looked at me with her mouth open.</i> See also open-mouthed.</i></p>	<p>V + O OR V + A (wide) + CLOSE, SHUT + 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: VS REFLECTS</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 = SAY + + OR C</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' + opening, openings. <i>... the opening of 'Nicholas Nickleby' on Broadway.</i> See also opening night.</i></p>	<p>V START + N UNCOUNT + SURV: IN 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? 7.2 you are paying great attention to what people say around you because you want to know some particular information.</i></p>	<p>PER: VS REFLECTS PER: VS REFLECTS</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. <i>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 realise 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></i></p>	<p>V + O = PER: VS REFLECTS PER: VS REFLECTS</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: VS REFLECTS PER: VS REFLECTS = 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: VS REFLECTS</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 = 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. <i>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></i></p>	<p>V + O = THROW WIDE + PER: USED AS A + 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. ... 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. to open your heart: see heart. See also open-minded.</i></i></p>	<p>V + O + N UNCOUNT + 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. + used as an adjective. <i>They try to keep the Pass open all winter.</i></i></p>	<p>V-ERG + POSSIBLE + 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. ... openness. <i>... their relaxed openness.</i></i></p>	<p>ADJ QUALITY PRES: + to FRANK</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. 27.2 it gradually becomes larger or wider until you reach the second place. <i>The passage opened out into a cavern.</i></i></p>	<p>V + A = LEAD V + O 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>+ N UNCOUNT ADJ QUALITY PRES: + 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. + used as an adjective. <i>The small white flowers are open in May.</i></i></p>	<p>V = UNFOLD + ADJ CLASSIF USED PRES</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: VS REFLECTS</p>

Figure 3

seem to link the various senses⁴, 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 nearly 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 is needed in addition is the notion of *contrast*: When we look for semantic commonalities between different (sets of) occurrences of one word in order to characterize its lexical meaning, then the contrast between this word and other words in the vocabulary is decisive. We cannot be satisfied with a meaning specification that is so general that it also covers occurrences of other words, unless these words are actually synonymous with the word whose meaning we are trying to characterize.

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 is 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 registers, 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*. Both types of cases are exceptions, arguably even diachronically unstable, and thus should not play a central role for the theory of lexical semantics.

Another important aspect to the role of lexical contrast for word meaning is this: If lexical contrast is used in the determination of lexical meaning then lexical meaning becomes *tied to individual languages*, because lexical contrast is of course a matter of a particular vocabulary. Hence it is *prima facie* unlikely that there should be 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 clearly a linguistic and language-specific notion and not a matter of general cognitive impact, as world knowledge on the other hand clearly is.

2.3 Lexical Meaning

A definition that may serve our purpose is this:

- (i) A meaning of a lexical item w is characterized by a set of entailments \mathbf{F} , such that
- \mathbf{F} is entailed by (the semantic representations of) all utterances u_i in which w has a regular occurrence. [maximality condition]
 - \mathbf{F} is not entailed by any u_i in which w is substituted for by a different lexical item, w' . [contrast condition]

⁴A limitation, and to my mind a serious problem, of this approach is that there is considerable difficulty in constraining these mechanisms so that they will yield all the senses that are required but do not, at the same time, get mechanisms of linguistic change going, i.e. generate senses that are not senses of the expression in question at the current state of the language but may be realized either in earlier stages of the languages or in language stages yet to come. Renate Bartsch (1984) has worked on such mechanisms and proposes that social norms will play the crucial role in constraining over-generation.

w is identified as a triple of attributes $\langle \text{CHAR}, \text{MORPH}, \text{SYN} \rangle$, for CHAR being a sequence of characters from the alphabet (alternatively, a phonetic characterization), MORPH being an inflectional paradigm, and SYN being a syntactic characterization by head features and subcategorization features. Lexical items that have the same MORPH attribute and differ in their spelling only within the range of the inflectional paradigm are thus counted as (forms of) the same lexical item w , provided they have the same SYN attribute.

A *regular occurrence* of w is an occurrence that is not embedded in an intensional (or opaque) context and is not anaphorical.

- (ii) Hence w is lexically ambiguous, and a set W_i of occurrences of w is attributed a lexical meaning different from the meaning attributed to the occurrences of w in W_j (for $W_i \cap W_j = \emptyset$) iff there is a set of entailments F' characteristic for all $w_j \hat{I} W_j$ and there is at least one occurrence w_i of w ($w_i \hat{I} W_i$), for which F' does not hold.

A few comments may be in order. First, the basic idea is that meaning is a matter of truth conditions, or, more empirically, of observable inferences from utterances in a context. Second, the relevant set of inferences is found with each occurrence of the lexical item in question and, at the same time, is not found with any occurrence of any other lexical item of the language. The latter assumption (i.e., the *contrast condition*) excludes synonymy and makes the notion of lexical meaning relative to the vocabulary of one language. The former assumption (*the maximality condition*) makes sure we cover as many occurrences of a lexical item as possible with just one lexical meaning.

A couple of remarks concerning the formulation of our definition: I said that a meaning is *characterized* by a set of entailments. By this I mean a one-to-one correspondence, without any prejudice to the ontology or metaphysics of meanings. Ontology and metaphysics are not my current concern. Further, I have spoken of entailments linked to semantic representations of utterances. This is not a purely empirical notion, but it can be approximated for practical purposes by the notion of *monotonic inferences from utterances*.

The identity conditions for lexical items we are using in the definition have as their consequence that the relatedness in meaning between two lexical items that differ syntactically but are related by a productive morphological relation is expressed as an inferential relation between the two meanings.

The restriction to *regular occurrences* of w makes sure that only those occurrences of w are counted in which the influence of w on the set of inferences drawn from the utterance is not corrupted by external factors that would influence the semantics of a clause or sentence always in the same way, independent of the lexical semantics of the expressions concerned.

Part (ii) of the definition only spells out a natural consequence for the notion of lexical ambiguity and does not add anything of substance.

I am aware that many linguists would regard both the maximality condition and the contrast condition as too tough requirements for natural languages. But such objections are likely to be due to a confusion: We are defining *lexical meaning* and not *observational utterance meaning*. Hence if lexical meanings turn out rather poor and underspecified on comparison with the inferences that we find with their actual occurrences, we must remember that lexical meaning only provides the bare bones for those inference sets and that the whole thing gets fleshed out with contextual information. - And if the objection is that

our definition of meaning could not account for the derivation of the large variety of inference sets observed in connection with one lexical item, we must remind the reader that our notion of lexical meaning can yield the required empirical consequences only in conjunction with a theory of polysemy (of which I shall provide bits and pieces below and of which a more comprehensive account is given in Bosch 1995).

2.4 *An example*

2.4.1 *Tests for identity of sense*

Before we proceed to apply our notion of lexical meaning to the example from Figure 3, I want to show that a presumed alternative, the identification of lexical senses by means of *identity of sense tests*, is of no help for this job.

Suppose we are confronted with the following occurrences of the English verb *to open*, assuming that these sentences are taken from reasonably well-behaved contexts, and our task is, first of all, to figure out, whether there is more than one lexical meaning of *to open* involved in these occurrences⁵.

- (4)
- a. She opened the door.
 - b. She opened the discussion.
 - c. She opened her mouth.
 - d. She opened her arms.

Applying common tests for identity of sense, like coordination or conjunction reduction, and VP anaphora (cf. Zwicky & Sadock 1975, Bosch 1985, 1991), we get results like the following:

- (5)
- a. She opened the door and her arms.
 - b. She opened the discussion, but not her mouth.
 - c. She opened the door, and he the discussion.
 - d. She opened her arms, but not her mouth.
 - e. She first opened her arms and then the discussion.
 - f. She didn't open the door, only her mouth.

All of these sentences would, in run-of-the-mill contexts, result in pretty odd utterances, displaying what in classical rhetorics is called *zeugma*⁶. Thus our tests would show that different senses of *open* are involved in each of the sentences in (4).

The variation in the interpretation of *to open* in (4) is triggered by a difference in the theme of the verb. But, as the following cases demonstrate, keeping the theme constant does not guarantee sameness of sense. Also modification of the VP can trigger further differentiation of the sense.

- (5)
- g. She opened the shop in 1972, and so did he this morning at 8.30.
(where she started a business in 1972 and he just unlocked the shop door)

⁵ Cf. for related observations Kay e.a.(1991)

⁶ Note that this is not due to the fact that the corresponding statements would not make sense. Each of the sentences in (5) has a non-odd paraphrase when conjunction reduction or VP ellipsis are avoided.

(6) **to open (intransitive):**

$$\begin{aligned} & \lambda x [\exists e ((\text{OPENING}(e) \ \& \ \text{THEME}(x,e)) \\ & \quad \vdash \quad (\text{TRANSITION}(e) \\ & \quad \quad \& \ \exists s_1 (\text{PRECEDING_STATE}(s_1,e) \\ & \quad \quad \quad \& \ \neg \text{OPEN}(x,s_1)) \\ & \quad \quad \& \ \exists s_2 (\text{RESULTING_STATE}(s_2,e) \\ & \quad \quad \quad \& \ \text{OPEN}(x,s_2)))] \end{aligned}$$

The first line gives a specification of the lexical meaning of the English verb *to open* in terms of a concept to which the lexical item refers. What follows are entailments tied to this concept: if something *x* is the THEME of an OPENING event, then *x* goes through a TRANSITION from a PRECEDING_STATE in which it is not OPEN to a RESULTING_STATE in which it is OPEN. The only information here that is specific to events of the sort OPENING is the concept OPEN in the description of the preceding and resulting states. The rest is general structure that is common to all events of the sort TRANSITION.

The first line of the (semantic part of a) lexical entry in (6), then, does no more than provide a *reference to a conceptual representation*, it functions only as a pointer to certain concepts. - Let us add another reading right away for the transitive use of *to open*.

(7) **to open something (transitive):**

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

The last line repeats the conceptual specification of intransitive *open* from (6). This (simple) concept of opening is here embedded in a causative structure, which, again, is not specific to the transitive verb *to open something*, but should recur in all conceptual representations of causative verbs.

The recurrence of the simple opening concept from (6) in (7) shows that there is an inferential relation between both representations, as specified in (8).

$$\begin{aligned} (8) \quad & \lambda x \lambda y [(\exists e (\text{OPENING}(e) \ \& \ \text{THEME}(x,e) \ \& \ \text{AGENT}(y,e))) \\ & \quad \vdash \quad (\exists e' (\text{OPENING}(e') \ \& \ \text{THEME}(x,e')))] \end{aligned}$$

i.e., if there is an opening event that has an agent and a theme then this entails another opening event which involves only that theme (in plain English: if someone opens something then this something opens). - We would expect to find the same kind of entailment with all ergative verbs; using Ψ as a variable for the specific event predicate we may write down the following "ergative rule":

$$\begin{aligned} (9) \quad & \lambda x \lambda y [(\exists e (\Psi(e) \ \& \ \text{THEME}(x,e) \ \& \ \text{AGENT}(y,e))) \\ & \quad \vdash \quad ((\exists e' (\Psi(e') \ \& \ \text{THEME}(x,e')))] \end{aligned}$$

The question whether or not this constitutes an interesting generalization is not our concern at the moment. A more important point is that even though it would suffice to put only reading (7) into the lexicon, marking it as ergative, and then derive (6) from (7) by means of the ergative rule, this would be no more than a space saving device. It would not reduce the number of lexical meanings of *to open* in the sense we defined lexical meaning. The meanings in (6) and (7) are distinguished by their argument structure and by their entailments, and predicting one of them on the basis of the other still would not do away with either of them. One may well argue that there should be a notion of lexical meaning that is independent of argument structure, but I fear that such a notion could not be founded in entailments and I don't know how such a notion could be defined.

Conceptual relations of the kind shown in (8) or (9), as well as the referential relations between a lexical item and a conceptual representation, must be distinguished from meaning postulates. Meaning postulates (for which we have no place in the present approach) postulate inferential relations between *linguistic expressions*, for instance:

$$\begin{array}{l} x \text{ opens at } t_0 \\ \vdash \quad x \text{ is closed } < t_0 \text{ \& } x \text{ is not closed } > t_0 \end{array}$$

Once we spell out what exactly these relations mean, we are forced to speak of relations between linguistic expressions *under a particular interpretation*, or between occurrence classes of expressions, and in the end we will presumably come up with pretty much the same we have stated above in terms of reference relations between expressions and concepts and entailment relations between concepts.

2.4.3 Conceptual ingredients

So far we have proposed a distinction between two different meanings of *to open*, linked to the transitive and intransitive constructions. These meanings are referred to by the corresponding lexical items and are specified in terms of conceptual representations.

An important fact about these two meanings of *to open* is that they are reduced to general concepts that are required for larger classes of verbs: ergativity, causativity, transition. The only conceptual ingredient that is not of this level of generality is the predicate OPEN(x,y). So far we have implicitly assumed that this predicate applies to pairs of things and states, i.e. things fall under this concept in particular states. This means that the same things could in principle also occur in states in which they do not fall under this concept - otherwise the relativization to states would make no sense. And this is already an important characterization of the concept OPEN. A full characterization of this concept would also require the specification of inferences that depend on the relativization to states and which are presumably different from the inferences that are linked to other concepts that describe states, such as, ALIVE, CLEAN, WET, etc. - just supposing for the moment that these are proper concepts and not just English adjectives printed in small capitals.

In order to clarify the concept OPEN(x,y), we have to consider not only its dependency on the states argument, but also the nature of the other argument: the sort of thing that OPEN can apply to.

As it happens, there is an English adjective that seems to refer pretty much exactly to the state concept OPEN, i.e., the adjective *open*. So let us ask first what sort of thing can be *open*. Anything that is, or has the function of, a *boundary* (such as a door, a gate, a lid) can be said to be *open*, but also objects that *have a boundary* (like a room, a box, a bottle) can be said to be *open*.

These two types of objects are conceptually closely related: any bounded object has the property of having a boundary, and for any boundary there is a bounded object it is the boundary of. The mapping from boundaries to bounded objects and conversely, however, is not generally a proper function. The reason is that, on the one hand, a bounded object may be bounded in several directions or in several ways, and it is an open question in each case whether the bounds of such an object are conceptualized as just one boundary or as several boundaries. A room, for instance, may have more than one door, and a room may also be said to be open when part of a wall or the ceiling is missing. - On the other hand, a boundary is in principle always a boundary between two objects, i.e., two spaces or areas. It is a matter of the conceptualization in the particular case at hand whether or not both objects are considered as bounded objects and whether the boundary is viewed as an attribute of one of the two objects. A door may be viewed as the door of a particular room to which it leads, but it may also be regarded as a door linking two rooms, belonging no more to one than to the other. Finally, a boundary may indeed be viewed non-relationally just as a boundary, and not as the boundary of something or between something and something else. The latter case occurs with bridges, roads, or mountain passes when they are said to be *open* or *closed*.

Considerations like these make it unattractive to reduce one of the two applications of the adjective *open* to the other. In terms of inferences: we might like to infer from the statement that a particular boundary is open the statement that a corresponding bounded object is open. And we can always do this, provided our boundary is conceptualized as a boundary of some particular bounded object. When this provision is not fulfilled, however, the inference cannot succeed. But even when the provision is fulfilled, the inference may turn out to be *uninteresting*, while the original statement was new and informative. Take the case of a statement that says that a particular door is open. This may be new information, while, at the same time, the inference that the room that the door belongs to is open is completely uninteresting, because it was known before that another door of the same room (and hence the room) is open. - In brief: the reduction of boundaries to bounded objects or conversely would make sense only if there were, at least conceptually, a one-to-one correspondence between boundaries and bounded objects. Only in that case would we have the same inferences from apparently equivalent statements about bounded objects and boundaries.

There are arguments to the predicate *open* that are not immediately recognizable as either boundaries or bounded objects. One can speak, e.g., of an *open character*, the *open sea*, an *open piece of land*, or an *open fire*. In some cases this may be a matter of the particular function of a boundary, i.e., the kind of access it permits or prohibits (e.g. visual access). We shall not discuss these cases here because the productivity of this class is limited as is shown by the fact that only attributive uses and no predicative uses of the adjective are available. You don't say, e.g., that *a fire is open* or that *the sea is open*, meaning that you are concerned with an open fire or the open sea. Hence one may well assume that although the meaning of the adjective *open* has figured in the historical origin of these expressions, the link between adjective and noun has become more intimate in these expressions than is good for compositional analysis.

2.4.4 Putting the ingredients together

The constraints over the arguments of the concept OPEN we just observed must recur as constraints over the theme of the verb *to open*, because the theme of *to open* occurs also as the argument of the

concept OPEN in the entailments in (6)⁸. Accordingly, we must differentiate both transitive and intransitive *open* with respect to their theme. Hence we will get four different meanings, depending on whether the theme is a boundary or a bounded object.

It may be thought that a further differentiation of themes for transitive *open* would lead to a difference in inferential options, and hence a difference in meaning. Common dictionaries would seem to take this assumption generally for granted. Cf. for instance the following uses:

- (10) a. She opened the door
 b. She opened the shop
 c. She opened the bottle

Sentence (a) would invite the inference that one could pass through the door, but (b) & (c) don't suggest that one could pass through the shop or bottle. (b) invites the inference that one could buy things in the shop, but buying things in a door or bottle seems odd.

But these differences need not be due to differences in meaning. They are better attributed to world knowledge: when an object of sort *s* is open (OPEN(*s*)), the consequences may be others than in the case where an object of sort *s'* is open (OPEN(*s'*)), depending on *s* and *s'*, e.g.,

$$(11) \quad \forall x \forall y [(CONTAINER(x) \& OPEN(x) \& \exists y (CONTENT(y,x))) \\ \rightarrow ACCESSIBLE(y)]$$

$$(12) \quad \forall x \forall y [(SHOP(x) \& OPEN(x) \& \exists y (GOODS(y,x))) \\ \rightarrow FOR_SALE(y)]$$

Note that these consequence relations are not entailments. They only hold by default and are defeasible by additional information: if a bottle (CONTAINER) is open and there is something in it (CONTENT), the content of the bottle may still not be accessible, e.g. when the content is not a liquid or not in a liquid state. And when a shop is open and there are goods in the shop, they may still not be for sale, e.g. when these goods have been sold already and are kept in the shop to be collected by the buyer. - If we were to allow non-monotonic inferences in the inference sets that constitute the meaning of a lexical expression, we would stand no chance to cover all occurrences of the expression in all contexts. There are always contexts in which such inferences are overwritten. - Surely, meaning must not be affected by varying assumptions about what the world may or may not be like and this is just one of many good reasons for keeping world knowledge distinct from meaning.

The assumption that the meaning of *to open* remains unaffected by its theme may seem to run into difficulties in cases like (10a), which exhibit an ambiguity that depends on the sortal properties assigned to the reference of the NP *the door*: the woman referred to may be *opening* the door in question either in order to enter or leave a room, or - in quite a different sense - in order to see whether the door is hollow inside. If we regard a door as a boundary, we get the first reading, and if we regard the door as a bounded three-dimensional object we get the second reading. - But the difference between boundaries and bounded objects is already taken into account by our distinction between two corresponding lexical meanings of *to open*.

⁸ It comes as no surprise after the discussion in the preceding paragraph that one can't *open the sea or a fire*, as in those cases we are not really concerned with the concept OPEN.

The earlier decision to keep boundaries and bounded objects distinct is supported by the consequences this decision has for the differences in the meaning of *to open*. If we were to derive the inferences belonging to one of the two meanings from the other, we would be claiming that saying that you want someone to open a window is rather a roundabout way of asking him to open the room of which the window forms a boundary and the request could be fulfilled also by opening the door instead. Another odd consequence would be that in a situation of a room with two doors, one of which is open, one could not possibly *open* the second door. For if one door is open, then the room is open and things that are open cannot be opened, hence, logically, no further door or window of the same room could be opened.

We thus feel confirmed in our decision with respect to the differentiation between boundaries and bounded objects and propose the following four meanings for the verb *to open*:

(14a) *to open a boundary*

$$\lambda x \lambda y [\exists e (\text{OPENING}(e) \ \& \ \text{THEME}(x,e) \ \& \ \text{AGENT}(y,e) \ \& \ \text{BOUNDARY}(x))$$

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

(14b) *to open a bounded object*

$$\lambda x \lambda y [\exists e (\text{OPENING}(e) \ \& \ \text{THEME}(x,e) \ \& \ \text{AGENT}(y,e) \ \& \ \text{BOUNDED_OBJECT}(x))$$

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

(14c) *a boundary opening*

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

$$\vdash (\text{TRANSITION}(e) \ \& \ \exists s_1 (\text{PRECEDING_STATE}(s_1,e) \ \& \ \neg \text{OPEN}(x,s_1)) \ \& \ \exists s_2 (\text{RESULTING_STATE}(s_2,e) \ \& \ \text{OPEN}(x,s_2)))]$$

(14d) *a bounded object opening*

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

$$\vdash (\text{TRANSITION}(e) \ \& \ \exists s_1 (\text{PRECEDING_STATE}(s_1,e) \ \& \ \neg \text{OPEN}(x,s_1)) \ \& \ \exists s_2 (\text{RESULTING_STATE}(s_2,e) \ \& \ \text{OPEN}(x,s_2)))]$$

2.4.5 *Opening ceremonies*

There is a kind of openings in which royal highnesses, first ladies, and various other celebrities indulge and which are, certainly at first blush, not always concerned with bounded objects or boundaries, but rather with events: openings of fairs, festivals, hunting seasons, etc. But there are also more profane events that can be opened, or that open, in this sense: parties, buffets, stock exchanges, businesses, speeches, letters. - In these uses of *to open* a paraphrase like *to start* or *to begin* gets close to the intended meaning.

But not just any old event that can *start* or *begin* can *open* or *be opened*: drinks, dreams, work, or your morning shower do not *open* and you do not *open* them when you start them. The additional requirement seems to be that for an event to be opened, the event must have a conventional structure of parts or sub-events: a bounded temporal entity with internal structure.

The internal structure is an important requirement. You can open a speech, a lecture, an argument, or a letter and you cannot open informal utterances that don't have the same conventional structure, such as a reply, a question, a text, an utterance. And when things like "she opened her question (by saying...)" are actually said, there is the suggestion that this question complies with the requirement of conventional structure. - Similarly when relatively informal and unstructured events like having a shower are described by saying "he opened his shower this morning..." the effect is that the morning shower gets the air of a ceremony.

A further requirement is that events that are opened do not just have an internal structure but have a clear starting point. This is why e.g. a wedding or a funeral cannot be opened, but only a wedding or funeral *ceremony* can be *opened*.

The effect of opening such events is often described by saying that they are *open* or have been declared *open*. And although for instance a party, a buffet, or a ceremony can be opened in this sense, one does not usually say that after the completion of the opening the party, buffet, or ceremony are *open*, although it can be said that they *have been opened*. The fact that this parlance is more common with festivals, a business, or the stock exchange is probably due to another reason: when things of the latter variety have been opened certain locations associated with them are open, i.e. accessible, while events that do not have these associated locations, like speeches, letters, formal statements, etc. are just taking their course as events.

This raises the question whether we should subsume the relevant meaning of *to open* under the opening of bounded objects, arguing that we are concerned with temporally bounded objects of a particular kind, or whether we should introduce a separate meaning that does not have the entailment that the event is OPEN but rather that the event is in progress.

The decision turns on the "meaning" of the concept OPEN, i.e., on the entailments that are linked to this concept. So far we have used the concept OPEN in application to BOUNDED_OBJECTS and BOUNDARIES. And the entailments are different in both applications. - In line with this policy I want to propose that we apply the concept also to events of the specified type. Since also in this understanding of *to open* both a transitive and intransitive construction can occur, again related by the ergative rule, we will have two further meanings of *to open*, as specified below.

(14e) *to open a structured event*

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

(14f) *a structured event opening*

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

Recall that the meaning specification for our six meanings of *to open* is given in the first line only and that the entailments only serve to link these meanings to other parts of the conceptual representation. The task of specifying the latter has not yet been accomplished by what we have done so far. This is obvious from the fact that all three transitive meanings and also all three intransitive meanings have the same entailments, with the only difference that the concept OPEN applies to different sorts of objects and hence should yield different entailments at a deeper level of analysis. E.g., we would expect entailments of the following kind:

$$\exists x [(\text{S_EVENT}(x) \ \& \ \text{OPEN}(x)) \\ \vdash \text{IN_PROGRESS}(x)]$$
$$\exists x [(\text{BOUNDED_OBJECT}(x) \ \& \ \text{OPEN}(x)) \\ \vdash \text{ACCESSIBLE}(\text{INSIDE_OF}(x))]$$
$$\exists x [(\text{BOUNDARY}(x) \ \& \ \text{OPEN}(x)) \\ \vdash \text{NON_OBSTRUCTIVE}(x)]$$

At this level of analysis further concepts ($\text{IN_PROGRESS}(x)$, $\text{ACCESSIBLE}(\text{INSIDE_OF}(x))$, $\text{NON_OBSTRUCTIVE}(x)$) are introduced that need to be integrated into conceptual knowledge by fixing the corresponding entailment relations. This task is completed only when there is a complete representation of a system of conceptual knowledge. When we are concerned with small parts of this system, as we are here, we can only make sure that we avoid ad-hoc concepts as much as possible and that we keep our representations as general as possible.

2.4.6 Cases not covered

Of course I want to claim that what I have covered in the above sample analysis of the adjective *open* and the verb *to open* are the central cases and any occurrences that don't fit the proposal are somehow less relevant. - But what would such a statement mean ?

I already mentioned cases that need not fit the analysis (*open character, open sea, open piece of land, or open fire*) and that may be viewed as idiomatic or as fixed lexicalized expressions whose internal analysis is about as exciting for the semanticist as the genesis and original meaning of a family name. It makes no sense in the conception of word meaning I am defending to mix in diachronic considerations: the conception of word meaning I have been putting forward is a structuralist one and is tied to a particular synchronic system of word meanings in a particular vocabulary. This system uses the relations of similarity and contrast as its crucial determinants and hence can only consider such elements of the vocabulary that may empirically be considered as standing to each other in relations of similarity and contrast. A lexical string whose meaning and use has changed through history, even though its form may have remained the same, is not an element of this kind because the relations of similarity and contrast in which it stands with respect to other lexical strings have changed through history.

Admittedly, the strict synchronic view that I am assuming is artificial in the sense that it uses the idealization of *a system of a language at a particular time in a particular community*. But idealization and abstraction is the price to be paid for a systematic inquiry. What is open to challenge is only whether our idealizations are the right ones.

3 Polysemy

Without really mentioning the topic we have implicitly proposed a treatment of polysemy, at least the kind of polysemy that is exemplified in (15) or in the dictionary extract of Figure 3.

- (15)
- | | | |
|----|----------------------------|------------|
| a. | She opened the door. | [=4a, 10a] |
| b. | She opened her mouth. | [=4c] |
| c. | She opened her arms. | [=4d] |
| d. | She opened the shop. | [=10b] |
| e. | She opened the bottle. | [=10c] |
| f. | She opened the discussion. | [=4b] |
| g. | She opened the trade fair. | |

The definition of lexical meaning given in Section 2.3 would tell us that there are three different senses of *to open* involved in (15): the *open_a_boundary* sense in (a,b,c), the *open_a_bounded_object* sense in (a,c,d,e,g), and the *structured_event* sense in (f). Thus (a) and (c) are straightforwardly ambiguous. But this still leaves us with some variation, at least to the extent that one would want to say that - leaving the ambiguities aside - *opened* does not "mean the same" in (a), (b), and (c), nor in (a), (c), (d), and (e), or, finally, in (f) and (g). - The grounds for saying this are in the different inferences that are invited by utterances of these sentences, as explained above.

On the account proposed, these phenomena are however no reason for the assumption of any further lexical meanings over and above those shown in (14a-f). The explanation for the additional inferences comes from the interaction of lexical meanings with information from the conceptual representation and contextual knowledge. Let me show this interaction in a couple of examples in detail.

Suppose we are interpreting (15b) in a context where little more is known than is of specific value to the interpretation of this utterance than the referent for the pronoun *she*: some woman, previously introduced by the name *Cynthia*. This gives us a representation of the referent that includes the properties human being and female. The actual process of anaphoric interpretation of *she* is not our

concern here. The next step concerns the VP *opened her arms*. The lexicon will give us the six meanings from (14), of which only the three transitive ones are relevant. They predict a theme, grammatically realized as a direct object, that must be of one of the following three sorts: STRUCTURED EVENT, BOUNDED OBJECT, or BOUNDARY.

The lexicon will give us for the noun *arm* a concept (let us assume here for brevity's sake that this concept has the name ARM), which is specified at least with respect to a supersort. Since it does not matter here what the properties of this supersort are, let us simply call the supersort S_ARM. - Now the sentence uses the expression *her arms* and refers to (again disregarding any problems of anaphora resolution) Cynthia's arms. We know that Cynthia is a human being and the generic knowledge representation should tell us that human beings have extremities, namely arms and legs, two of each. This helps us interpreting the plural so that we know it's the two arms of Cynthia that she opens.

How do the available OPEN concepts combine with this CC representation of her arms. We need a mechanism that places our CC of Cynthia's arms under one of the superconcepts STRUCTURED EVENT, BOUNDED OBJECT, or BOUNDARY. Since arms are physical objects, they are naturally also BOUNDED OBJECTS. This gives us one interpretation already, on which Cynthia is practicing surgery on herself: opening her arms as bounded objects.

Another interpretation is forthcoming when we subsume her arms under the superconcept BOUNDARY. Here we need to know in what sense a person's arms can form a BOUNDARY or, more generally, we will need a mapping of what we know about Cynthia's arms onto the attributes of the concept BOUNDARY. This interpretation is also in play when we interpret expressions like *she put her arms around him*, or *she took him into her arms*. It is clear from this example that the process of subsumption, the viewing of somebody's arms as a boundary, requires a good deal of knowledge about the use we make of our arms (say, as opposed to our legs, toes, or fingers, but similar to the use we make of our hands). I am not altogether sure that all of this information can be captured in conventional formats of knowledge representation, say, in description logics, but the essential point here is only that it can be captured in *some* format of representation on which we can run processes of inference. Even though the details of such representations are likely to be not entirely trivial, I will here just assume that these problems can be solved.

The last option for combining the verb to open with Cynthia's arms would be to subsume Cynthia's arms under the concept of a structured event, thus mapping properties of her arms onto the attributes of the concept of a STRUCTURED EVENT. Without pushing our imagination beyond reasonable boundaries no CC that would fulfil these constraints seems to be forthcoming. Hence there is only one solution open: forgetting all we know about Cynthia's arms and setting up a fresh CC that satisfies the requirements of the superconcept STRUCTURED EVENT and that can be referred to by the expression *her arms*. We may take the entire expression as a proper name of some structured-event-type object: why shouldn't we have, next to the *King's Arms*, the *Farmer's Arms* a new feminist pub called *Her Arms* and have Cynthia open it ? Another option would be to take only the noun *arms* as a proper name and reading *her* as a regular possessive pronoun with reference to Cynthia, never mind what *arms* would be a proper name of.

So the idea of our polysemy treatment can be summarized in the notion of *Dynamic Subsumption*: the addition of a CC to the knowledge representation that satisfies the constraints that come from supersorts introduced by subcategorization as well as from the lexical semantics of the expression in question and the influences that the context has already had, i.e. the CC already attached to the lexical

expression at the point of interpretation. The latter can in principle always be overruled by a mechanisms like the interpretation of an expression as a proper name. - Clearly, this is not a comprehensive treatment⁹ of polysemy yet, but only shows some essential ingredients in order to make clear that the separation between lexical meaning and conceptual representation which is proposed in this paper may well pay off also in the treatment of follow-up problems in the area of polysemy.

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⁹ A more comprehensive treatment of polysemy is offered in Bosch (1994).