could point our errors, unclarities, omissions, etc. to me. You can send comments, reactions and questions to the following e-mail address: deswart@csli.stanford.edu. Your help is much appreciated!

Chapter 1

What is meaning?

The first question in approaching semantics as the study of meaning is: what is meaning? Another issue to be addressed is the relation between meaning, mind, and world, and its effect on the organization of a semantic theory. Finally, we will discuss the place of semantics in linguistic theory, and the borderline between semantics and pragmatics.

1.1 Language and meaning

Semantics is defined as the study of meaning expressed by elements of a language or combinations thereof. Utterances are not just noises or scribbles, they are used to convey information, they are linked with kinds of events, with states of mind, etc. Speaker and hearer use language to *communicate*. Typically, communication involves a message encoded by the sender into some kind of signal and sent through a channel to the receiver, who receives the signal and decodes the message. In a regular speech situation, there is a speaker who is the sender, and the message is what she wants to get across to the hearer, who is the receiver. The signal consists of sound waves, which encode words and sentences, the channel is the air, and the hearer decodes the sound waves.

Communication is only successful if the idea the hearer gets is the same as what the speaker intended the hearer to get. One requirement is that

speaker and hearer share a language, so that they know how to do the encoding and decoding. This knowledge of the language system which is stored in the brain is what Chomsky (1965) refers to as the speaker's *competence*. Competence is contrasted with *performance*, which applies to the use of the language system. Even people who master their language to perfection make mistakes: they speak in ungrammatical sentences, stumble over their words, or misinterpret perfectly grammatical sentences. Such performance errors reflect the actual processes that go into production and understanding of language. The notion of linguistic competence abstracts away from the actual process to study the knowledge native speakers have of their language as an abstract cognitive system. Linguistic competence involves more than being able to make the right sounds. Parrots and certain other birds can be taught to make articulate sounds, but they do not relate these sounds to content. Because of that, we feel they are not competent speakers of the language: the sounds they make do not convey information and do not achieve communication. It is the fact that linguistic expressions are not just *forms*, but have *content* which makes language such a suitable tool for communication. Competent speakers are those who know not only the forms and the contents, but also the link between them. It is the task of a semanticist to describe the meaning of linguistic elements and to study the principles which allow (and exclude) the assignment of meaning to combinations of these elements. In addition, a complete and adequate semantic theory characterizes the systematic meaning relations between words and sentences of a language, and provides an account of the relations between linguistic expressions and the things that they can be used to talk about (i.e., the external world).

If we define semantics as the study of meaning, we should like to know what exactly it means to *mean* something. The question of what the meaning of meaning is has been studied by philosophers of language as well as linguists. The words *to mean* or *meaning* occur in all kinds of natural language sentences, such as the ones listed in (1).

Dictionaries give *signify, import, denote, represent* as synonyms of *to mean* and provide descriptions such as 'to be defined or described as, to denote, to convey' for (1a)–(d), 'to convey the same sense as, to refer to the same thing as' for (1e), 'to imply, to result in' for (1f, g), 'to design for a certain purpose' for (1h), 'to intend to convey or indicate' for (1i, j), 'to be of a specified importance or significance, to matter' for (1k), etc.

The noun *meaning* is described as 'something that is signified, something that one wishes to convey, especially by language' for (1l), 'something that is felt to be the inner significance of something' for (1m). *Sense, significance, signification, acceptation* and *import* are given as synonyms.

In order to create some order in this diversity it is important to restrict

(1)
a. The word "dog" means a certain species of mammal.
b. The red light means that you cannot go in.
c. Those clouds mean rain.
d. {a,b,c} means 'the set consisting of the elements a, b and c.'
e. The French word "chien" means "dog".
f. This will mean the end of our regime.
g. His losing his job means that he will have to look again.
h. This building is meant for storage.
i. I mean to help if I can.
j. What do you mean by that look?
k. The opinions of critics meant little to him.
l. Do you know the meaning of the word hypochondriac?
m. What is the meaning of life?

the notion of meaning in which we are interested. We will stay away from moral values such as the specified importance or the inner significance of things. This excludes examples like (1k) and (m) from our theory of meaning. Furthermore, we will ignore purposes and intentions, and thus leave cases like (1h), (i) and (j) outside the discussion. We will replace the informal use of *to mean* in (1f) and (g) by the formal term *to imply*. We will furthermore restrict ourselves to meaning conveyed by symbolic systems, which removes examples of 'natural' meaning like (1c). This leaves us with the cases in (1a), (b), (d), (e) and (l) and the paraphrases *to denote*, *to be described or defined as* and *sense, denotation, signification, acceptation* as the core meaning of meaning.

We will furthermore restrict our notion of language, because there are various kinds of languages:

(2)
a. Natural languages such as English, Chinese, Sanskrit, sign languages like ASL (= American Sign Language), etc;
b. Complementary sign systems which function in communication, such as smiling, gesturing, shaking hands, etc;
c. Sign languages for specific purposes, such as traffic signs, secret codes, the Morse code, etc;
d. Formal languages such as algebraic languages, programming languages, first order predicate logic, etc.; and
e. languages or communication systems of other animals such as bees, dolphins, apes.

This list may not be exhaustive, but it shows that there is a lot of

diversity in sign systems. They can all be said to have their own syntax and semantics. The overall theory which tries to develop a unifying analysis of these systems is called *semiotics*.

In this course, we will limit ourselves to natural language, so we will not try to account for examples like (1b), which involves a sign system like in (2c). Examples like (1d) have a special status, because the semantics of formal languages such as programming languages, logical languages, etc. is fully defined and specified as part of the description of the language when we learn it. This implies that there is a set of rules which (recursively) define the meaning of any well-formed expression in the language. We do not need to 'go out in the field and search for' the meaning of an expression, because it is already there and we have defined exactly what it is.

If things were as easy for the semantics of natural language, we would long have finished the job. (Un)fortunately, this is not the case. For one thing, determining the meaning of a natural language expression is an empirical matter. It turns out that it is not so easy to define a set of rules which recursively define the meaning of any well-formed expression of English, French, Chinese, Navajo, ASL, etc. Given that *direct interpretation* of natural language with respect to the outside world (or some model of it) is not always so easy, many semanticists opt for the *indirect* approach. We know that a translation can sometimes help us to determine the meaning of an expression. Suppose I speak French, but you don't, and we both speak English. In that case, I can teach you something about the meaning of a French expression by translating it into English. In such a setting, I could utter a sentence like (1e). If you know the meaning of the word *dog* in English, you have now learnt the meaning of the word *chien*, because my utterance established an equivalence relation between the two word meanings. The same 'trick' can be used with the translation of natural language into some formal language. Suppose I can describe the meaning of an English expression by translating it into an expression of a formal language. Because there will be a full and explicit interpretation procedure for the expressions in this formal language, I will immediately have grasped the meaning of the English expression. Of course, I will only have access to it in an indirect way, namely via a translation procedure, but as long as the translation is perfect, the exact meaning will be captured. But that is of course the critical point. It is essential to have a formal language which does indeed qualify as an adequate translation for English. As you may expect, this issue is far from trivial. The development of a family of formal languages which capture increasingly complex parts of the meaning of natural language runs through this book like a continuous thread.

1.2 Meaning, mind, and world

People hold different views on the relation between language, states of mind and the outside world. A *mentalistic* approach to meaning claims that words primarily stand for ideas (concepts, images, thoughts, ...). This is an attractive view, for nobody will deny that we have mental representations and concepts, and that we reason with them. Language is in the brain, and for that reason linguistics is a branch of cognitive science, on a par with psychology and neuro-sciences. But it is not easy to build a psychologically realistic theory of meaning. A conceptual analysis works pretty well for names like *Pegasus* or *the Eiffel Tower*. They are the kind of words which immediately call up a mental image of the object. If we build into the theory a notion of *prototype*, we can extend this to common nouns such as *bird, dog, triangle* and verbs like *walk, kick, laugh*. For instance, a robin is a more typical bird than a penguin, so the mental image of the word *bird* will probably more closely resemble a robin, but this is not in any way incompatible with the existence of atypical birds like penguins. The mental approach is harder to apply to words that do not have clear conceptual content. We have difficulty defining the mental image associated with *only*, or *hello*. Another issue to worry about is the definition of meaning beyond the word level. We need to define mental operations which build complex concepts out of atomic ones in order to be able to assign a concept to a sentence, because sentences are clearly meaningful. We also have to avoid making mental concepts too private. The concepts and their modes of composition need to be intersubjective in order to allow communication between individuals. There are various proposals for mental operations of this kind. Fodor (1975) appeals to the notion of a language of thought to build the structure of more complex mental concepts. Johnson-Laird (1983) uses the notion of 'mental model' to describe complex mental structures. In a series of books and articles, Jackendoff develops a conceptual semantics which mixes ideas coming from predicate logic (see chapter 4), theories about thematic roles that are concerned with who is doing things (agent), and who or what is undergoing the action (patient), and psychological theories on (visual) perception (Jackendoff 1972, 1983, 1990). For instance, Jackendoff (1996) presents an analysis of the composition of verbs and their arguments which explains why the combination of *push* and *a cart* in the verb phrase *push a cart* introduces a spatial path along which the cart is moved indefinitely, whereas the combination of *eat* and *an apple* in the verb phrase *eat an apple* introduces a mapping from parts of the apple to parts of the event in such a way that an apple is gradually consumed in a finite period of time. Although analyses like these are an important step forward, the construction of complex concepts is a problem which has not

yet been entirely solved. It is not by itself impossible to define operations on concepts, but we have to make sure those operations are as psychologically realistic as the atomic concepts. The question of what counts as a psychologically realistic operation on conceptual meanings is not so easy to answer.

An important problem for the mentalistic approach is that this approach does not give us a clear view of the relation between words, concepts and the outside world. Concepts stand for objects in the world derivatively, because the ideas or concepts themselves stand for those objects. But this seems to push the problem of external significance from expressions to ideas. As long as we do not know how ideas classify objects in the outside world, this does not help much. Many researchers working in the mentalistic approach are less concerned with external reference than with cognitive representations, so not everybody takes this to be a serious problem. For instance, Larson and Segal (1995) make it the explicit aim of semantic theory to account for the part of our linguistic knowledge which concerns meaning. Their enterprise is rooted in the cognitivist perspective of generative grammar (Chomsky 1986, Higginbotham 1985). However, we cannot deny that one of the important characteristics of natural language expressions is that they are *about* something. If I said 'The book is on the table' in a situation where there is clearly a contextually relevant book visible on a contextually relevant table, then this sentence would accurately describe the situation. You would probably tell me that I am right. But if I removed the book from the table, you would no longer agree with me if I uttered the same sentence. People have quite solid intuitions about the relation of the sentence to the two situations. This intuition of external reference is something we want a semantic theory of natural language to capture. We use language to communicate, to talk about things outside, about the way the world is (or should be). This 'aboutness' of natural language suggests that meanings are not just things in our head, something like a mental or conceptual representation, but that they are somehow connected to the outside world. In sum, language has content and this content is anchored to reality via some aboutness relation.

Researchers who take the aboutness of language as a core property in view of its relevance for communication have developed approaches to meaning in which the main focus is on the external significance of language, on its connection with the described world, rather than the describing mind. In this view, sentences are classified by the way they describe things to be. In a referential theory of meaning, the relation between linguistic expressions and things in the world is defined as a relation of *reference*. The notion of reference has to be taken in a rather broad sense here. Words *refer* to all kinds of things in the world: objects, properties of individuals, relations between individuals, events and situations. An approach that establishes a direct relation between words and the objects they represent does not exclude that we also talk about non-existing objects such as Pegasus and Santa Claus, or the largest prime number or the present king of France. What is even more important is that it does not ignore the study of verbs expressing mental states and attitudes, such as hopes, beliefs, dreams. In fact, within the referential framework there is a considerable amount of linguistic and philosophical literature on the similarities and differences between such sentences as (3a) and (b):

(3) a. Bill Clinton gave a speech on television last night.
b. Sue dreamt she kissed Bill Clinton last night.

(3a) is a statement about the real world, and it is a matter of checking whether the sentence is true or false. In (3b) the situation is more complex. There are two individuals in the real world involved (Sue and Bill Clinton), there is a real world event (a dream) and there is an event in Sue's dreamworld (a kissing). (3b) is an example of the problem of *intensionality*: we refer to a world which is not the real world. Predicates like *to dream*, but also *to believe, to think* are called 'world creating' predicates, because they introduce their own possible 'world', which is not necessarily identical to the real one. The creativity of the human mind allows us to make these imaginary worlds as complex as we like (just think about fiction). Sentences like (3b) show that language also serves to communicate about mental states with other persons. In a referential theory of meaning, it is important to be able to represent information about mental states as well. But even the semantics of world creating predicates and other intensional expressions will ultimately be formulated in terms of reference, albeit reference at different indices. Not just the reference here and now in the real world comes into play, but the reference in other situations as well (see chapter 9 for more details).

Note that there is no implication that the representations in a referential theory of meaning have psychological import. The theory is used in explaining our knowledge of language, but makes no claim about how we know these things, what kind of knowledge this is, or how it is stored in the brain. It does not aim to be more than an account of what it is that we know when we know a language. In that sense, it aims at equivalence with, rather than identification of, our mental representations. As such, a referential theory of meaning does not claim to be psychologically realistic, but to be compatible with a theory which is.

Ideally, we would want to build a theory which combines insights from both the mentalistic and the referential theory and analyzes meanings as

relations involving three things: expressions of language, objects in the world and mental states of the speaker and hearer. There is currently an attempt to bring the different frameworks closer together as a first step towards building a theory of that kind. See Gärdenfors (1994a, b), and Zwarts and Verkuyl (1994) for more discussion.

1.3 The place of semantics in linguistic theory

In linguistics, the term *grammar* is often used to describe what internal knowledge fluent speakers possess of their language–their *linguistic competence*. Whatever fluent speakers know of their language is a proper part of a description of that language, and belongs to the object of study of linguistic theory. Given that speakers know what the morphemes, words, sentences and discourses of their language mean, semantics must be a component of the grammar. Moreover, it was mentioned above that we use language to communicate, to talk about things in the outside world, to convey information about the way the world is (or should be). The 'aboutness' of language, and the important role that that notion plays in communication is one of the motivations to adopt a referential approach to meaning. The fact that communication consists in the transmission of information provides an additional argument in favor of the view that semantics is a genuine part of linguistic theory.

Quite generally, we can say that there are three essential ingredients to the use of language as a means of communication, namely:

(i) the linguistic expression(s) used

(ii) what the expression refers to
(objects, properties, relations, events, ...)

(iii) context

Syntactic research focusses primarily on (i), especially on the structure of larger units such as the sentence. One issue that syntacticians are interested in is word order. The English, Dutch and French embedded sentences in (4a–c) all have a subject, a verb and a direct object, but the order of the words is systematically different in the three languages:

(4) a. (I saw that) the student wore a red sweater [English]
b. (Ik zag dat) de student een rode trui droeg [Dutch]
(J'ai vu que) l'étudiant portait un pull rouge [French]

The subject in (4a–c) consists of a noun (N) and a determiner (Det). The combination of these two words builds a complete nominal constituent, called a noun phrase (NP). In all three languages, the determiner is placed left of the noun. The rest of the sentence says something about the subject. We call this the verbal predicate or the verb phrase (VP). The VP in (4a–c) consists of a verb (V) and a direct object (an NP). The object is a more complex noun phrase than the subject, because it also contains an adjective. Both English and Dutch place the adjective between the determiner and the noun. French places most (but not all) adjectives after the noun. If we look now at the order of the subject (S), the verb (V) and the object (O), we observe that the order of these elements in English and French is SVO, whereas the Dutch order is SOV. Syntacticians work on theories which capture the differences and similarities between the structure of phrases and sentences in the languages of the world.

Semantic research focusses on the relation between (i) and (ii), in particular on the meaning which arises out of the combination of more elementary expressions into groups of words and sentences. If we look at the examples in (4) again, we observe that they all express the same meaning: there is a certain individual who is characterized as a student, and this individual has the property of carrying a red sweater. This is a complex property which can be further analyzed into a relational expression (the verb) and the object the student has a relation with (a red sweater). The object has to have a combination of two properties: it has to be a sweater, and it has to be red. Although the order of the words in (4a–c) is different, the procedures which combine the meanings of the elements into a more complex meaning are the same. This underlines the observation that all languages are equal in that they have the same communicative possibilities. As a result, semantic variation is more constrained than syntactic variation.

It is the introduction of structure which takes semantic theory beyond the definition of the meaning of a list of words. This view on the relation between syntax and semantics reflects the intuition that it may be possible–and even fruitful to some degree–to study structure without reference to meaning. For instance, there may be elements which are indispensible for the well-formedness of a complex expression, but which do not themselves contribute essentially to the interpretation. Although we can study structure without meaning, we cannot study meaning without structure. A meaning is always the meaning of something, and that something must be a syntactic expression. Preferably this expression is syntactically well-formed, but with examples like (5) communication can be successful even if there is a grammatical error:

(5) a. *I aren't tired.
b. *La porte est ouvert. [French]
the-[fem] door is open-[masc]

Given that syntactically ill-formed sentences are often interpretable, we cannot claim that such expressions do not have meaning. But the more general claim stands, namely that for complex expressions there can be no meaning without structure. Semantics is always relational, and as a result, semantics always needs syntax. However, if we are interested in language as a means of communication, we do not want to do pure syntax, just in order to do syntax. In this perspective, it is not very useful to develop a grammar without an interpretation of the expressions built up by the syntax. The conclusion must be that we do not want to develop a grammar without interpretation, and that syntax and semantics go hand in hand. This is a core element in the view of grammar developed by Montague (1973), which is known as *Montague grammar*. Other theories of grammar have inherited the idea that syntax and semantics are closely tied together, for instance Head Driven Phrase Structure Grammar (HPSG) (Pollard and Sag 1994) and Lexical Functional Grammar (LFG) (Dalrymple et al. 1995).

Pragmatics studies the relation between (i) + (ii) and (iii) and focuses thereby on language in the context of use. Communication often goes well beyond the meaning of what is said. Suppose someone utters (6):

(6) It's warm in here.

If this is uttered when speaker and hearer have just entered a tropical greenhouse in the middle of a cold winter, the speaker probably just makes a (correct) observation about the difference in temperature inside and outside. In such a context (6) is used as a descriptive statement. But if someone comes to my house on a hot summer day and utters the same sentence, I will probably take that to mean that the speaker does not appreciate the temperature inside the house. This may lead me to turn on the air conditioning or to open a window to have some fresh air. So there is a difference between *sentences* and *utterances*: one and the same sentence uttered in two different contexts constitutes two utterances, and the information these utterances get across may be quite different. Given that the context of use determines to a considerable degree the way linguistic meaning works out in a particular situation, we distinguish between *sentence meaning* and *utterance* or *speaker's meaning*. Any act of communication takes place in a specific context, so communication always relies on utterance meaning. On the other hand, our linguistic capacity is clearly independent of any specific context in which we utter a sentence. The study of the interpretation of sentences belongs to grammar. Semantics is thus about the study

of literal, context-independent meaning. *Pragmatics* is interested in how sentences work out in context, and is therefore concerned with utterance meaning. This includes the study of nonliteral meaning such as irony (7a) and metaphor (7b, c):

(7) a. Oh, that's just great! (upon discovering your bike has a flat tire when you are in a hurry to get home)
b. She is a real treasure.
c. They just wouldn't swallow our idea.

There are systematic ways in which hearers build up ironical and metaphorical meanings when the literal interpretation of a sentence is clearly inadequate in the context. Knowledge of the world, conceptual schemas that describe stereotypical courses of events (scripts or frames), and well-known figures of speech are used as interpretation strategies that build up contextualized (utterance) meaning on the basis of literal (sentence) meaning. For more discussion, see Searle (1979), Lakoff and Johnson (1980).

The notion of context includes the 'setting', that is the time and location of the utterance, which involves the language user in the role of speaker and hearer. The crucial role of the context of use is visible in the interpretation of deictic elements such as *I, here, now* (Levinson 1983). The following example about deixis is from Barwise and Perry (1983). Suppose Alex utters (8), speaking to Bertha, and Bertha uses the same words, talking to Alex:

(8) I am right, you are wrong.
a. Alex to Bertha: Alex is right, Bertha is wrong.
b. Bertha to Alex: Bertha is right, Alex is wrong.

The two people talking to each other use exactly the same words, but they obviously disagree forcefully with each other. Alex and Bertha make rather different claims about the world: what Alex said will be true if Alex is right and Bertha is wrong, whereas what Bertha said will be true if Alex is wrong and Bertha is right (compare 8a and b). These different claims are the different interpretations of the utterances. But the meaning of the sentence they both used did not change. Even though the two utterances have the same sentence meaning, the utterance meaning is different, because the reference of *I* and *you* changes from one utterance to the next. Deixis shows that utterance meaning cannot be fully determined by sentence meaning. We need to take into account certain features of the speech situation which directly affect the reference of a deictic expression. The interpretation of tense and temporal expressions such as *yesterday, last week* is also deictic and crucially dependent on the setting:

(9) Last week I played tennis with Chris.

We calculate the reference of *last week* as 'one week back in time from now', and whether the sentence is true or false depends on where the 'now' of the utterance is located in time. Every moment the reference of *now* changes. Yet the word does not change its meaning when it changes its reference. If it did, we could never find out what it means, and we couldn't understand what the speaker was trying to communicate. The context-dependent character of deictic expressions makes their analysis essentially a pragmatic matter (see Levinson 1983 for more discussion).

Context can also be more generally the real world or the fictional world the expression is related to. World knowledge often comes in when we discuss notions like coherence. For a long time, world knowledge was like a pragmatic wastebasket into which everything was thrown which couldn't be explained by syntactic or semantic rules. More recently, researchers have started sorting out some of the contents of this wastebasket, as it turned out to contain valuable information necessary to build machines which can model natural language understanding (think of applications in the areas of artificial intelligence and machine translation). A typical kind of puzzle in this respect is *anaphora resolution*. An *anaphor* is an incomplete expression which depends for its interpretation on some other element in the sentence or in the context. The expression the anaphor is dependent on is called the *antecedent*. For instance, the antecedent of an anaphoric pronoun like *he, she, they* tells us which individual(s) the pronoun refers to. Anaphora resolution is the process which involves finding the right antecedent for the anaphor, so that we resolve the identity of the individual(s) the pronoun stands in for. In some cases, the referent of the pronoun is fixed by the utterance situation. Consider (10):

(10) (Jane pointing to Bill): "He is the one I saw on the night of the party."

Jane's pointing gesture picks out the reference of the pronoun *he*. Because the referent is directly determined by the situation of utterance, we talk about a deictic interpretation of the pronoun. Unlike the first and second person pronouns *I* and *you*, third person pronouns are not inherently deictic. In the absence of a pointing gesture, the referent of the pronoun is usually determined by the linguistic context. We call this an anaphoric interpretation of the pronoun. In the easiest case, there is only one appropriate antecedent available in the context, as in (11):

(11) Jane$_i$ came home around five. Bill stood up and greeted her$_i$.

The pronoun *her* points to a female referent. In (11), there is only one female referent in the discourse, and the pronoun is naturally linked to Jane. The subscript i on the proper name and the pronoun is a syntactic device which is commonly used in linguistics to describe the (semantic) link between the anaphor and its antecedent. Other cases are more complex; compare (11) and (12):

(12) a. I took my daughter$_i$ to the dentist$_j$ this morning. She$_j$ told her$_i$ it wouldn't hurt too much, but she$_j$ would give her$_i$ a pain killer anyway.
b. I took my daughter$_i$ to the dentist$_j$ this morning. She$_i$ asked her$_j$ if it would hurt and how long it would take.

In (12) there are two potential referents for each of the occurrences of the pronouns *she* and *her* and no grammatical rule determines the linking. General knowledge about the relation between dentists and their patients predicts a certain behavior for each of the participants. The notion of *script* or *frame* is often brought in to describe such fixed patterns of behavior for certain common real life situations. Our knowledge of this stereotypical behavior determines the preferential coindexing in (12a) and (b). Note that the indices only indicate the result of the pronoun resolution process: they show how the pronouns are resolved, not how we achieved this. Typically, a mixture of linguistic and non-linguistic knowledge comes in to determine where the indices should go.

Not all world knowledge is located in scripts or frames. The rules which determine the preferential coindexing in (13) are dependent on specific knowledge about a particular person. The following example is from Kameyama (1996):

(13) a. John hit Bill. *He* was severely injured.
b. John hit Arnold Schwarzenegger. *He* was severely injured.

In (13a), the preferred reading is that Bill was injured because of John hitting him. A hearer who does not know who Arnold Schwarzenegger is will interpret (13b) no differently from (13a). But those of us who know Arnold as a strong, almost invincible superhuman individual will tend to take John as the injured person in (13b). Because we know Arnold is stronger than the average person, we jump to the conclusion that John will probably suffer for his attack.

Computational linguists are interested in combining linguistic and world knowledge to develop algorithms for anaphora resolution that solve puzzles like the ones in (12) and (13). In this book, we will mostly limit ourselves to (some of) the grammatical rules that govern the anaphor-antecedent

relation (see in particular chapter 5 and chapter 6. In some sense, we try to maximally exploit linguistic knowledge before giving in to 'knowledge of the world'. Whether this is the most efficient strategy from a computational point of view is open to debate.

1.4 Exercises

Exercises marked with an exclamation mark (!) are for discussion in class or section.

(1)! Explain why communication is likely not to be successful in the following situations in terms of encoding and decoding of the message sent by the speaker and received by the hearer by means of some signal travelling through some channel:

(i) Context: semantics class at Stanford university, 3rd week of the quarter, so far all lectures have been taught in English. Utterance: 'Je suis votre nouveau prof de sémantique. Ouvrez vos livres à la page 23 s'il vous plaît.'

(ii) Context: audience of deaf people at an ASL meeting. Utterance (in English): 'We all want to encourage the use of ASL in a larger community.'

(iii) Context: exhausted visitor arrives at destination after a long trip. Dialogue:

* (visitor to host): 'I am really thirsty.'
* (host to visitor): 'Are you? I am sorry to hear that.'

(iv) Context: Alice visits Humpty Dumpty. Dialogue (Humpty Dumpty starts): 'There's glory for you!' 'I don't know what you mean by 'glory',' Alice said.
Humpty Dumpty smiled contemptuously. 'Of course you don't—till I tell you. I meant 'There's a nice knock-down argument for you!' '
'But 'glory' doesn't mean 'a nice knock-down argument', ' Alice objected.
'When *I* use a word, ' Humpty Dumpty said, in rather a scornful tone, 'it means just what I choose it to mean—neither more nor less.'
'The question is.' said Alice, 'whether you *can* make words mean so many different things.'

(2)! Putnam (1975, 1988) notes that elm trees are not maple trees, and that most speakers know that elm trees are not maple trees—in other words, they know that *elm* does not mean the same as *maple*. Yet many of these same speakers cannot tell an elm tree from a maple tree; the knowledge they have in their heads is not sufficient to differentiate these kinds of trees. The same is true for many other *natural kind terms*—common nouns that denote kinds of things in nature, such as aluminum versus molybdenum, gold versus pyrite ('fool's gold'), diamonds versus zircons. We are all confident that these pairs of words are not synonymous, yet many people's concepts contain no information sufficient to distinguish one member of each pair from the other. Thus, it is clear that normal speakers do not have a determinate concept of the things these words denote. Explain the problems this raises for (i) a mentalistic theory of meaning and (ii) a referential theory of meaning. Putnam suggests that there is a 'division of linguistic labor' in language, in that normal speakers depend on and defer to 'experts' in these matters. To determine whether a tree really is an elm or a maple, one consults a tree specialist. To determine whether a metal is gold or pyrite, one consults a metallurgist. And so on. These experts have procedures, based on scientific understanding, for determining the category of the object. With respect to these terms, then, reference is in part a social phenomenon. Explain how the appeal to specialists helps us to solve the problem of the meaning of elms trees and maple trees, diamonds and zircons, etc. in the perspective of (i) a mental theory of meaning and (ii) a referential theory of meaning.

(3)! The examples in (i)–(iii) are all odd as sentences of English. (i) is syntactically ill-formed and semantically uninterpretable. (ii) is syntactically well-formed, but semantically anomalous. Is the oddness of (iii) due to syntactic or semantic problems? Motivate your answer.

(i) Jimmy Sara to herself asked kiss.

(ii) The blue sky asked a myth to kiss itself.

(iii) Sara asked Jimmy to kiss herself.

(4) Describe how scripts or frames figure in the interpretation of the following sentences. Explain why these examples involve definite descriptions, rather than pronouns:

(i) The last time I ate here, I had to wait 15 minutes before *the waiter* brought me *the check*.

(ii) When Ted was driving home yesterday, he had to step on *the brake* suddenly, and *his head* went through *the windshield*.

(ii) Whenever I teach freshman algebra, *the girls* do better than *the boys*.

(5) Consider the implications in (i) through (vi). Are they to be accounted for by linguistic theory alone, or by linguistic theory in conjunction with other theories? Explain which parts of linguistic theory come into play in the analysis, and which other theories (if appropriate).

(i) 'To Harry, Bill gave a shirt' implies 'Bill gave Harry a shirt'.

(ii) 'John invited Mary' implies 'Mary was invited by John'.

(iii) 'Eva got up late' implies 'Eva did not get up early'.

(iv) 'Steve is human' implies 'Steve is a mammal'.

(v) 'Steven is a jerk' uttered by Harry implies 'Harry thinks Steven is an annoying person'.

(vi) Communication between Bill (speaker) and Mindy (hearer) on Tuesday morning: 'I would like to invite you to the party tonight' implies 'Bill would like to invite Mindy to the party on Tuesday night'.

Chapter 2

Desiderata for a theory of meaning

Now that we have defined semantics as the study of meaning expressed by elements of a language or combinations thereof, we can investigate the issues a semantic theory should address. First we need to know what the meanings of words in the language are. Then we need to find a way to semantically combine elements of a language and build up complex meanings. We will make some decisions as to the organization of our semantic theory, and introduce the principle of compositionality of meaning and a strict distinction between object language and metalanguage.

2.1 A structured lexicon

If we think about meaning in a 'naive' pre-theoretic way, the first thing which comes to mind is the meaning of *words*. In learning a foreign language, we think we learn the syntax by studying a grammar book and the semantics by learning the vocabulary, the *lexicon* of the language. In fact, we can already study meaning below the word level. The conventional view of linguistics has it that phonology studies the clustering of acoustic properties into minimally distinctive units, the phonemes. The minimal