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I am grateful to the University of Canterbury for study leave during the first semester of 2009, during which this edition was written.

I also wish to thank all the students and teachers around the world who have emailed me with queries and comments on the first edition. These messages have been very helpful in deciding what to change, and it has been a pleasure to hear from people who are using the book. Students in my own classes have provided lively and interesting feedback over the last few years, and I have enjoyed and valued their discussions.

Finally, I thank the anonymous reviewers who first gave very helpful comments on a rather cursory outline of the proposed new edition, which greatly clarified my thinking on what was needed, and then gave invaluable feedback on the first full draft.
Preface to the First Edition

This book grew out of a semantics course taught at the second-year level in the general Arts or Sciences bachelor’s degree at the University of Canterbury, New Zealand. Most of the students are studying linguistics or philosophy as a major subject, but they also come from a number of other fields in the humanities, physical sciences or professional studies. They generally have taken an introductory course in either linguistics or philosophy.

A mixed undergraduate class in semantics presents the dilemma of deciding what to do about the conceptual and notational complexity of formal theories. A detailed formalization procedure is not of the greatest interest to many of the students, and if the full formal apparatus is used, it isn’t possible to introduce more than a limited range of data. If a very limited range of data is covered, this leaves a gap in the linguistics programme, particularly for the teaching of syntax, where some acquaintance with semantic issues is increasingly useful and important. The aim of this book is to introduce a wider range of topics in formal semantics with a limited formal apparatus.

Chapters 1–4 are introductory to the rest of the book, but a selection can be made from the remaining chapters. There are several themes that could be followed: Chapters 4–6 cover NP interpretation and Chapters 8–10 cover events and thematic roles. Verbal and nominal aspect is covered in sections of Chapters 6 and 7 and Chapter 9.

The text is intended to be used as a coursebook, accompanied by lectures on the topics covered and by discussion of the exercises. This book is not a ‘teach yourself’ text for private, unassisted study. The exercises included are of varying difficulty – some are for basic review and are suitable for private revision, but the more demanding of exercises may best be used as the basis of class discussion sessions.

As always, students are urged to also read other introductions to semantics which take a different approach.
All the chapters in this edition have been revised, some extensively.

The main new content is a new chapter introducing formal composition, including type theory and the lambda calculus, at a genuinely introductory level suitable for beginners. A simpler set of rules using first-order functions only (with one small exception) is covered up to and including Section 4.5, with Exercises (5) and (6) based on this material. This can be used as a more basic unit. Section 4.6 introduces second-order functions, with Exercises (7)–(10). However, I have decided not to use the compositional approach as the main framework throughout the book, for two main reasons. First, there is always a tension between concentrating on formalization skills and introducing a wide range of semantic issues and phenomena. This text aims to introduce a wide range of issues, and accordingly, I have retained a simplified presentation of formalization. Second, this text generally assumes little or no background in syntactic theory, but the syntactic structures associated with the binary composition of, for example, tense, modality and quantifier NPs is fairly advanced. A simplified transformational account of quantifier NPs in object position is outlined, but in general I have omitted semantic composition associated with advanced syntactic structures. Where compositionality is discussed, I have included exemplar tree diagrams for students to follow in doing the exercises.

Along with a greater focus on formal theory, I have removed the short section on lexical semantics and reduced the discussion of pragmatics, which is now discussed in Chapter 1 on a ‘need to know’ basis. That is, I have introduced the main kinds of pragmatic inference, such as scalar implicature, which can be intuitively hard to separate from a literal truth condition. I have also added a descriptive section on presupposition, and brief coverage of indexicality and anaphoricity.

The chapter on thematic roles has been updated and clarified, including a new, fairly comprehensive section on the motivation for and formalisms of lexical conceptual structure (LCS), with particular focus on thematic roles in LCS. The chapter on tense and aspect is also fairly extensively revised, with a full discussion of the analysis of reference to times in a narrative in Discourse Representation Theory.

There are new exercises throughout the book, and many existing exercises have been revised. The exercises are now marked with an indication of level of difficulty: * for basic, ** for intermediate, *** for advanced, and one or
two with **** for very advanced. Some of the exercises are also marked as recommended for discussion.

Overall, I intend the book to be useful for true beginners, including those with very little background in linguistics or philosophy. However, the phenomena and analyses are intrinsically of different levels of complexity – in particular, analysis of generalized quantifiers as lambda functions and the section on lexical conceptual structure may be more suitable for intermediate and advanced students.

Feedback from readers has shown that the book is used for a wide range of teaching situations, and many instructors are using selected topics only – indeed, it would be impractical to attempt to cover everything in a semester. I have increased cross-referencing and briefly repeated information in some places in order to make it easier to use certain parts of the book independently. For example, it should be possible to use the chapter on tense and aspect without previously reading the chapter on aktionsarten if you wish, or to use the chapter on referential opacity without reading the material on generalized quantifiers.

Thank you for flying with us – I hope you have an interesting and enjoyable trip.
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1.1 Semantics and pragmatics

The study of linguistic meaning is generally divided in practice into two main fields, semantics and pragmatics. **Semantics** deals with the literal meaning of words and the meaning of the way they are combined, which taken together form the core of meaning, or the starting point from which the whole meaning of a particular utterance is constructed. **Pragmatics** deals with all the ways in which literal meaning must be refined, enriched or extended to arrive at an understanding of what a speaker meant in uttering a particular expression. This division can be roughly illustrated with (1) below:

(1) I forgot the paper.

Semantics provides the literal meaning of the elements *I, forget, past tense, the* and *paper*, and the meaning drawn from the order of the words, giving very approximately ‘The person who is speaking at some time before the time of speaking forgot a particular item which is a paper’. Pragmatic considerations flesh this out to a more complete communication.

Suppose that it is Sunday morning. Anna, the speaker, has just returned to her flat from the local shops where she went to buy croissants and the Sunday newspaper. In this context her flatmate Frances understands Anna to say that she forgot to buy a copy of the Sunday newspaper for that morning, and the time of her forgetting was while she was at the shops – she presumably remembered her intention to buy a paper when she set out and has obviously remembered it on returning. If the shops are nearby, Anna might also intend Frances to infer that Anna will go back for the paper.

Suppose, alternatively, that a man has been found murdered in the fields near a farmhouse. Two nights before the body was found the farmhouse was broken into, although nothing was reported missing. The owners of the house are renovating a small upstairs room, and the floor of this room is currently littered with sticky scraps of stripped wallpaper. The dead man was found with a scrap of the wallpaper on the sole of his shoe. Two detectives are discussing the
case. One has just finished speculating that the murder is connected to another set of recent events in the nearby town, and is not related to the break-in at the farmhouse. She then stops and says ‘I forgot the paper’. In this context her colleague understands her to mean that while she was working through her alternative scenario she forgot the wallpaper scrap on the dead man’s shoe. Given the background assumption that the scrap of paper proves the man’s presence upstairs in the farmhouse at some stage, her utterance is also understood to mean that she withdraws her speculative alternative scenario, which is probably not correct.

Examples like these demonstrate the enormous contribution of pragmatic information to communication. On the other hand, the starting point from which we arrive at both fleshed-out meanings is the constant contribution of the literal meaning of *I forgot the paper*.

This book will mainly concentrate on literal meaning, the content of words and expressions which is fairly constant from one occasion of use to another. The next part of this chapter will review some of the main issues in the analysis of literal meaning. After that, we will consider some important kinds of pragmatic meaning which may be difficult to distinguish from literal meaning.

## 1.2 Kinds of meaning

### 1.2.1 Denotation and Sense

There are two most basic ways of giving the meaning of words or longer expressions. The first and most simple way is to present examples of what the word denotes. For example, the word *cow* can be defined by pointing to a cow and saying ‘That is a cow’, or the word *blue* can be defined by pointing to a blue object and saying ‘That colour is blue’. Definition by pointing to an object of the kind in question, called *ostensive definition*, appeals directly to the denotations of the words defined. The word *blue* denotes the colour blue, or blue objects in the world, and the word *cow* denotes cows. The general point is that linguistic expressions are linked in virtue of their meaning to parts of the world around us, which is the basis of our use of language to convey information about reality. The denotation of an expression is the part of reality the expression is linked to.

The second way of giving the meaning of a word, commonly used in dictionaries, is to paraphrase it, as illustrated in (2):

\[
(2) \quad \begin{align*}
\text{forensic} & \quad \text{‘pertaining to courts of law and court procedures’} \\
\text{export} & \quad \text{‘to send out from one country to another, usually of commodities’}
\end{align*}
\]

This kind of definition attempts to match the expression to be defined with another expression having the same sense, or content. The clearest kind of sense-for-sense matching is translation from one language to another. To say
that *le train bleu* means ‘the blue train’ is to say that the French expression and the English expression have the same sense.

The most widely discussed form of the sense/denotation distinction is the **sense/reference** distinction. An expression which denotes just one individual is said to **refer** to that individual. Titles and proper names are common referring expressions. Suppose, for example, that some of the previous winners of the Mr Muscle Beach Contest are Wade Rodriguez (1934), Denzel Lucas (1987), Josh Minamoto (2001) and Rob Cabot (2009). The expression *Mr Muscle Beach* has a constant sense which one might paraphrase as ‘(title of) the winner of an annual body-building competition called the Mr Muscle Beach Contest’, but depending on the year in which, or about which, the expression is used it refers to Rodriguez, Lucas, Minamoto or Cabot. This general pattern of a constant sense allied with changeable reference is discussed in more detail in Chapter 7.

Sense and denotation do not have parallel status. In the context of the anecdote above the expression refers at different times to Wade Rodriguez, Denzel Lucas, Josh Minamoto and Rob Cabot. The fact that the expression refers to one of these men at a given time depends on, and follows from, the sense of the expression. It is only because the expression has the sense ‘(title of) the winner of an annual body-building competition called the Mr Muscle Beach Contest’ and Lucas won the competition in 1987 that the expression refers to Lucas in 1987. And given the sense of the expression, it cannot denote anyone who has not won the competition in question. So sense is more basic than denotation, and denotation is dependent on sense.

Sense and denotation are the fundamental aspects of meaning in general. The next two sections review different ways of partitioning complex meanings in terms of their components.

### 1.2.2 Lexical and structural meaning

The meaning of a complex expression such as a sentence is composed of **lexical meaning**, which is the meaning of the individual words, and **structural meaning**, which is the meaning of the way the words are combined.

Structural meaning mainly comprises the meaning derived from the syntactic structure of an expression, for example:

(3)  

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<tr>
<td>a</td>
<td>The rat that bit the dog chased the cat</td>
</tr>
<tr>
<td>b</td>
<td>The cat that chased the dog bit the rat</td>
</tr>
<tr>
<td>c</td>
<td>The rat that chased the cat bit the dog</td>
</tr>
<tr>
<td>d</td>
<td>The dog that chased the rat bit the cat</td>
</tr>
<tr>
<td>e</td>
<td>The dog that bit the rat chased the cat</td>
</tr>
<tr>
<td>f</td>
<td>The dog that chased the cat bit the rat</td>
</tr>
<tr>
<td>g</td>
<td>The dog that bit the cat chased the rat</td>
</tr>
<tr>
<td>h</td>
<td>The dog that chased the cat chased the rat</td>
</tr>
<tr>
<td>i</td>
<td>The dog that chased the rat chased the cat</td>
</tr>
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<td></td>
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</table>

... and so on ...
From a vocabulary of seven words (the, that, rat, dog, cat, chased, bit) we can construct a large number of different sentences with different meanings, all based on a single syntactic structure with a common ‘meaning template’:

\[(4) \ [\text{The A [that B-ed the C]}] \ D-ed the E\]
\[\begin{align*}
    x & \text{ is an A} \\
    y & \text{ undergoes the D action} \\
    z & \text{ is the undergoer of the B action}
\end{align*}\]

The meaning components outlined in (4) are examples of syntactic meaning.

Any theory of human language has to be compatible with the fact that human languages are instantiated in human minds, which have a finite capacity. Although the language known by any one person at a given point in time contains a fixed number of words, it can in principle produce, or generate, infinitely many sentences, because the syntax is recursive. **Recursiveness** is the property of embedding a phrase inside another phrase of the same kind, which allows for sentences to be extended in length indefinitely. The examples below illustrate two kinds of recursion many times repeated:

\[(5) \quad \begin{align*}
    a. \ & \text{The car broke down because Tom forgot to fill the tank because he was running late because Bill rang him just when he was leaving because Bill wanted to sell John a home gym because he doesn’t use the home gym anymore and he needs the money because he spent too much money last month because he went for a quick holiday because he needed a break...} \\
    b. \ & \text{This is the maiden all forlorn that milked the cow with the crumpled horn that tossed the dog that chased the cat that killed the rat that ate the malt that lay in the house that Jack built.}
\end{align*}\]

The examples in (5) show that recursion can be used to lengthen a sentence by adding to it. For example, the sentence *The car broke down* can be lengthened by adding *because Tom forgot to fill the tank*, giving two sentences, the original one and the longer one. In principle, any sentence can be used to form a new sentence by using a recursive addition, and so the number of sentences is infinite. Given that the language has infinitely many sentences, our knowing a language cannot possibly amount to memorizing its expressions. Rather, we know the vocabulary and the syntactic rules for generating sentences. The syntactic rules themselves are a finite number, probably a fairly small number.

We can also match meanings to these infinitely many sentences, and again, we can’t possibly do this by memorizing sentence/meaning pairs. Most of the sentences we hear and understand are heard for the first time, and could not have been learned ahead. It must be that along with the syntactic rules for forming phrases and sentences, we also know interpretation rules which combine
meanings just as syntactic rules combine forms. Accordingly, linguistic meaning is compositional. Compositionality is the property of being composed from parts. Compositionality in semantic analysis is discussed in Chapter 4.

Structural meaning also overlaps with the meaning of syncategorematic expressions, introduced in the next section.

### 1.2.3 Categorematic and syncategorematic expressions

The distinction between categorematic and syncategorematic expressions applies to individual words, rather than phrases. Meaningful inflections can also be included here, as they are syncategorematic.

Categorematic expressions, which include the vast majority of words, are the descriptive words such as nouns, adjectives and verbs. These words are termed categorematic because their descriptive content, or sense, provides a basis for categorization. For example, the descriptive content of the word chimney provides the basis for forming the category of chimneys, the sense of blue provides the basis for the category of blue things, the senses of the words domestic, professional, commercial, and so on provide the basis for categories of things and activities, and so on.

Syncategorematic words are all the rest, including the examples here:

(6) as, some, because, for, to, although, if, since, and, most, all, ...

What syncategorematic words have in common is that they do not have independent, easily paraphraseable meanings on their own, and we can only describe their meanings by placing them in a context. Unlike the categorematic words, they are not themselves descriptive of reality, and do not denote parts of reality. Rather, they serve to modify categorematic expressions or to combine them in certain patterns.

Examples of modifying expressions are tense, illustrated in (7a–c), and modality, illustrated in (7d). (Modality and tense are discussed further in Chapters 5 and 9.)

(7) a. He believed us.
   b. He believes us.
   c. He will believe us.
   d. He might believe us.

In (7a–c) the tense endings -ed and -s and the future auxiliary will are combined with the same base sentence form He believe us. The basic sentence form describes a state of affairs, and semantic tense locates this state of affairs in the past, present or future. The past, present or future content of the tense expressions (-ed, -s, will) doesn’t stand alone, but must combine with a base sentence form to be given a particular interpretation. The same base sentence He believe us appears in (7d), but here the state of affairs of his believing us is not located in the past, present or future. Rather, the modal verb might expresses the possibility of such a state of affairs existing.
An example of a syncategorematic expression combining descriptive expressions is *all* in the examples below:

(8)  
   a. All diamonds are hard.  
   b. All dogs like icecream.  
   c. All zinks neb.  
   d. All A B.  

(All As are B or All As B)

The general form of the framework for *all*, given in (8d), is just as clear when filled with nonsense words as in (8c). *All* sets up a relationship between A and B. Thinking in terms of categories, we can say that ‘All A B’ places the A category inside the B category – the Bs include the As. For example, the category of hard things includes the category of diamonds (8a), the category of icecream-likers includes the category of dogs (8b), and the category of nebbers, whatever they are, includes the category of zinks, whatever they are (8d). The meaning of *all* is defined in terms of the way it relates the meaning of the A predicate to the meaning of the B predicate, rather than being defined apart from a context, and this gives *all* a syncategorematic character. (The quantificational determiners, including *all*, are discussed in Chapter 6.)

In summary, lexical meanings may be either categorematic or syncategorematic. Syncategorematic expressions, both words and parts of words like tense endings, group naturally with structural meaning, because they must be defined in terms of the constructions they appear in.

(9)  

\[
\begin{align*}
\text{lexical meaning} & \leftarrow \text{categorematic expressions} \\
\text{structural meaning} & \leftarrow \text{syncategorematic expressions} \\
& \leftarrow \text{syntax}
\end{align*}
\]

### 1.3 Truth-conditional theories of meaning

#### 1.3.1 Denotations

A long-standing and influential view about language is that the meaningfulness of language amounts to its ‘aboutness’. Words and expressions symbolize and describe – and are thus about – things and phenomena in the world around us, and this is why we can use language to convey information about reality. Accordingly, the meaningfulness of language consists of connections between words and expressions and parts of reality.

As we saw earlier, the part of reality a linguistic expression is connected with is the expression’s denotation. A name, such as *Midge*, *Rinny* or *Keeper* has the thing it refers to as its denotation. Suppose that the names in (10) all refer to dogs. (Note that when a word itself is referred to it is presented in italics e.g. ‘the name *Midge*’ but ‘the dog Midge’.)
Names don’t describe the things they refer to. Most personal names are coded as male or female by convention, but the convention can be broken, as in the case of the American actress Michael Learned, who has a first name usually given to boys; female forms of the name include Michaela and Michelle. Names which are based on meaningful expressions don’t have to be given to people who fit the meaning; an ugly man can be called Beauregard and a blonde woman can be called Melanie. In short, the apparent descriptive content that some names have isn’t relevant to determining what their denotation is.

In contrast to names, descriptive words like brown, coughs, skyscraper and indignant can only denote things that they do describe – words like these, which are categorematic, are called predicates. Most predicates are nouns, adjectives and verbs, and their denotations are the sets of things they apply to or are true of, for example:

\[
\begin{align*}
(10) \quad & \text{name: } Midge \\
& \text{denotation of } Midge = \text{Midge (She is a small brown dog)} \\
& \text{name: } Rinny \\
& \text{denotation of } Rinny = \text{Rinny (He is a fox terrier)} \\
& \text{name: } Keeper \\
& \text{denotation of } Keeper = \text{Keeper (He is a faithful hound)}
\end{align*}
\]

At first, this analysis for the meaning of predicates seems a bit thin. Take, for example, the meaning of brown as the set of brown things in the world. Is that all there is to it? Suppose the world was exactly the way it is except for one detail – a certain brown pottery bowl on a windowsill in Ladakh is blue instead of brown. If the world was like that instead of how it is, then the set of brown things would be different, but surely the word brown wouldn’t have a different meaning. This seems to make the word meaning depend on accidents of fate. We want to take into account the way the word brown would relate to the world even if things were a bit different from the way they actually are.

We want to take into account not only the objects a predicate happens to apply to in fact, but also all the hypothetical objects that it would apply to, meaning what it does mean, if things were different. Dog applies to all actual dogs and hypothetical dogs, grin applies to all actual and hypothetical creatures that grin, and so on. We need to consider hypothetical versions of the whole of reality to state what individual predicates would apply to in virtue of their meaning. Words connect not only with the real world, but also with other possible worlds.
1.3.2 Possible worlds, extension and intension

The term possible worlds is used in semantics for hypothetical ways reality might be or might have been. The way things actually are is the actual world, and it is included in the possible worlds because it is obviously a possible reality. A possible world different from the actual world is a whole alternative universe, not just an alternative version of Planet Earth. There are infinitely many possible worlds.

Many possible worlds have dogs in them, which the word dog applies to. We can collect together all the dogs in the real world to form the set of all real dogs – this set is the extension of dog. To get closer to what we think of as the ‘real meaning’ of the word dog we need the intension, which is the set of all dogs in all possible worlds. This comprises the full possible range of doghood. So there are two kinds of denotation for predicates:

(12) word (noun): dog
    extension: the set of all dogs in the actual world
    intension: The set of all dogs in all possible worlds

word (adjective): brown
extension: the set of all brown things in the actual world
intension: the set of all brown things in all possible worlds

word (verb): grin
extension: the set of all creatures that grin in the actual world
intension: the set of all creatures that grin in all possible worlds

1.3.3 Truth conditions

The analysis of sentences centres on declarative sentences – declarative sentences are the sort that can be used to make statements.

For example, we need to establish how the whole sentence Midge is grinning connects with the world. The sentence accurately describes part of the world, if in fact it is the case that Midge is grinning. If she is, the sentence is true. To find out whether the sentence is true you have to know what it means so that you can identify which facts are relevant: in this case, you have to find Midge and check her facial expression.

So a sentence is true or false depending on whether or not its meaning ‘matches’ the way reality is. If you know the relevant facts about reality and you know what a sentence means, then you know whether it is true or false. If you know what a sentence means and you know that it is true, then you know the relevant facts. If you know a certain fact, and you know that the truth of a particular true sentence depends precisely on this fact, then you know what that sentence means.

Extensions and intensions for sentences establish connections with reality in terms of truth. They work a little differently from extensions and intensions for predicates. The extension of a sentence is its truth value – that is, either true or false, depending on whether or not the sentence is true in the actual world. The intension of a sentence is the set of all possible worlds in which that sentence
is true, for example:

(13) sentence: *Midge is grinning*
    extension: truth value (true or false) in the actual world
    intension: the set of all possible worlds in which *Midge is grinning* is true

The intension of a sentence is also called the truth set for the sentence.

In theories of this kind the sense of a predicate is analysed as its intension. Correspondingly, a sentence intension (or truth set) stands for the sense, or meaning, of a sentence, which seems odd – how can the meaning of a sentence be a set of universes? The example *Midge is grinning*, if true, directly describes a state of affairs in the actual world of Midge having a certain expression on her face. Why isn’t that state of affairs the semantic value of the sentence?

A few more examples will show that the actual world is not enough to pin down a sentence meaning, and that other worlds are also needed.

Suppose the sentences below are true, and think of the situations they relate to.

(14) a. Midge isn’t purple.
    b. Midge isn’t white.

First locate the situations – presumably they are wherever Midge is. Now how can you tell the difference by looking at the world between Midge’s not being purple and Midge’s not being white? The actual situation of Midge’s being brown gives you the truth of both (14a) and (14b). The sentence meanings can’t be told apart just from looking at the actual world, in which they are both true. But they can be separated if all the possible worlds are brought into play.

There are possible worlds containing Midge in which she is purple – call the set of all those worlds WP. Then there are worlds in which she is white – call the set of all those worlds WW. Now *Midge isn’t purple* is true not only in the actual world, but also in every other possible world containing Midge except the worlds in WP. Similarly, *Midge isn’t white* is true in all possible worlds containing Midge – including the actual world – except the worlds in WW. So although these two situations can’t be told apart in a single situation where they coincide, they can be distinguished if we consider all the worlds where those situations occur. The truth set for *Midge isn’t purple* is a different set from the truth set for *Midge isn’t white*, which shows that the two sentences have different meanings.

The worlds in which the situation of Midge’s not being purple occurs are the worlds in which *Midge isn’t purple* is true – in other words, the intension or truth set of *Midge isn’t purple*. The truth set for *Midge isn’t purple* is like a complete specification of every possible version of a situation of that kind, combined with every other possible way that reality, apart from Midge’s colour, might have been. The truth set for *Midge isn’t purple* will be different from the truth set for any other factual sentence, unless it means the same thing. (A factual sentence is any sentence which is true or false according to how things actually are.)

Sentence X in (15) below stands in for any factual sentence at all that does not mean the same as *Midge isn’t purple*. Whatever Sentence X is, there will
always be at least one world where one of these combinations of truth values occurs:

(15) Sentence X  Midge isn’t purple
    true     false
    false    true

Suppose that Sentence X is *Midge is coloured*. Then in all the worlds where Midge is purple, *Midge isn’t purple* is false and *Midge is coloured* is true. Suppose Sentence X is *Midge is green*. In any world where Midge is brown, *Midge is green* is false and *Midge isn’t purple* is true.

So long as they differ by at least one world, the truth sets or intensions for two sentences are different, and the sentences have different meanings. This argument applies to any factual sentence at all in the place of Sentence X. *Midge isn’t purple* has a different intension, by at least one world, from any other factual sentence – it is unique. If a factual sentence turns out to have the same intension as *Midge isn’t purple*, then it has the same meaning. *Midge n’est pas violette* and *Midge ist nicht violett* are sentences with the same intension as *Midge isn’t purple*.

Using all the possible worlds, we can also deal with *Midge is purple*. Given that Midge is brown, this sentence is false, and doesn’t match up to any situation in reality. Even if we locate Midge in reality, as we have seen, her brownness is evidence for the falsity of *Midge is green* or *Midge is yellow* just as much as for *Midge is purple* – the actual world has no particular relationship with any false sentence, and can’t help us pin down its meaning. To give the meaning of *Midge is purple* (or any false sentence) we need the set of all worlds where it is true.

To say that a sentence is true if and only if a certain circumstance or state of affairs is actually the case is to state the conditions under which the sentence is true. Accordingly, to state the required circumstance is to state what is called the truth condition for a sentence. Many theories analyse sentence meaning in terms of truth conditions, and such theories are called truth-conditional theories. Theories which analyse meaning in terms of referring to, denoting or describing things, situations and events in the world (or in possible worlds) are denotational theories. Most formal semantic theories are both denotational and truth-conditional.

So far, the tools we have to analyse meaning are these: we have reality itself, also called the actual world, and all the infinitely many possible alternative ways reality might have been – these are the possible worlds (including the actual world). Given the possible worlds, we have both extensions and intensions for linguistic expressions.

- The extension of a name is its actual referent.
- The extension of a predicate is the set of things in actuality that the predicate applies to, or is true of.
- The extension of a sentence is its actual truth value, true or false.
- The intension of a name is its actual referent wherever it occurs in any possible world. (This point will be discussed further in Section 5.5.)
The intension of a predicate is the set of all things the predicate is true of in all possible worlds.

The intension of a sentence is the set of all worlds in which the sentence is true – the truth set or truth condition.

1.3.4 Truth-based relations between statements

The notion of truth underlies several important properties of statements, outlined briefly here. A statement \( A \) entails a statement \( B \) if wherever \( A \) is true, \( B \) must also be true: in other words, \( B \) is an entailment of \( A \). Some examples of entailment are shown in (16):

\[
\begin{align*}
(16) & \quad \text{a. ‘The door is open’ entails ‘The door is not closed’.} \\
& \quad \text{b. ‘Leo is shorter than Dan’ entails ‘Dan is taller than Leo’.} \\
& \quad \text{c. ‘The solution is odourless’ entails ‘The solution does not smell of cloves’.
}\end{align*}
\]

A statement \( A \) is a contradiction of \( B \) if \( A \) and \( B \) cannot both be true in any circumstances. If the contradictory statements \( A \) and \( B \) are conjoined in a complex statement \( D \), then \( D \) is also called a contradiction. Contradiction is illustrated in (17):

\[
\begin{align*}
(17) & \quad \text{a. ‘Jones is at home’ contradicts ‘Jones is not at home’, and vice versa.} \\
& \quad \text{b. ‘This clock is fast and slow’ is a contradiction.}
\end{align*}
\]

A contradiction can never be true because only one part or the other can be true in any given circumstance. On the other hand, a tautology is a statement which is always true and cannot be false, as in (18):

\[
\begin{align*}
(18) & \quad \text{a. When Jones was walking his feet moved.} \\
& \quad \text{b. The universe is either expanding or not expanding.}
\end{align*}
\]

Another truth-based (and much-debated) property of statements is the distinction between analytic and synthetic statements. An analytic statement is said to be true depending simply on the sense of the words in which it is expressed, and not on particular facts about how things are. For example, you can judge (19a) to be true without knowing which particular animal is referred to, because the word tigress already contains the information that its denotation is female. A classic analytic statement has the form illustrated in all of (19a–c), where the predicate repeats some content which is already expressed in the subject:

\[
\begin{align*}
(19) & \quad \text{a. That tigress is a female.} \\
& \quad \text{b. Red wine is coloured.} \\
& \quad \text{c. The murdered man was dead.}
\end{align*}
\]

A synthetic statement is any statement which has its truth value determined by the way things are and not just by the senses of the words in it. The
introduction

synthetic statements in (20), in contrast to the statements in (19), cannot be judged true or false without knowing the facts about the particular tigress or liquid referred to:

(20)  a. That tigress is pregnant.
     b. The distilled liquid was a rich purple.

Of these properties, entailment is the most important and most often encountered in semantic analysis. The notion that statement \( A \) entails statement \( B \) can also be informally expressed as ‘\( B \) follows from \( A \)’. But the idea that ‘\( B \) follows from \( A \)’ can also include some other relations different from basic entailment, which we consider in the rest of this chapter.

1.4 Implicature

Recall the two anecdotes at the beginning of this chapter which gave quite different total interpretations for the utterance of *I forgot the paper*. In the first case, Anna says ‘I forgot the paper’ to communicate that while she was at the shops she forgot to buy the newspaper, and possibly also to mean that she’ll go back and get it. In the second case, the detective says ‘I forgot the paper’ to communicate that while building her theory of the murder case, she forgot to account for the scrap of wallpaper stuck to the dead man’s shoe, and so she withdraws her speculative theory as unsatisfactory. In each case, the extra bits of information which are not expressed by the literal meaning of the words *I*, *forgot*, *the* and *paper* (and the sentence syntax) are inferred by the hearer from the particular context in which the utterance occurs, and any other background knowledge that is relevant. So, for example, in the first case the *inferences* that Frances draws from Anna’s utterance include the following bits of information: the paper refers to a copy of the day’s newspaper; the time of Anna’s forgetfulness was while she was at the shops; what Anna forgot to do was to buy the newspaper (not read it or burn it); and possibly, Anna intends to return to the shops immediately to buy the newspaper.

Most normal communication includes this kind of inference-drawing to a greater or lesser extent. The hearer effortlessly and without conscious awareness fleshes out the literal meaning of what the speaker said to construct a message which is most plausibly what the speaker intended to convey. Conversely, the speaker speaks in such a way as to allow the right inferences to be easily drawn by the hearer. Both participants are actively engaged in understanding and being understood, and in this sense normal communication is co-operative. As we have seen, the hearer’s part is to draw appropriate inferences. The speaker’s co-operative role is to enable the hearer to draw the right inferences, or in other words, to ‘invite’ the right inferences. An invited inference is called an *implicature*, and is implicated by the speaker.

The philosopher Paul Grice outlined a framework for analysing implicature in which he identified four main rules (or maxims) for the co-operative speaker to follow, but in fact two of the four maxims do almost all the work. Subsequent
research has largely converged on two major principles that guide the hearer’s drawing of inferences and the speaker’s inviting of inferences (or implicating). These are the Principle of Relevance and the Principle of Informativeness.

1.4.1 The Principle of Relevance

The Principle of Relevance states that what the speaker says should be relevant to the current concerns of the communicators. Conversely, the hearer should assume that what the speaker says is currently relevant and draw inferences accordingly. The Principle of Relevance pervades the inferencing in the anecdotes we started with. Consider: it is perfectly possible that the detective intended to buy the newspaper on her way to work, where she normally shares it with her colleague if they have a coffee break, but on this day she forgot to buy the newspaper. In the right circumstances (a coffee break) she could say to him ‘I forgot the paper’ and he would instantly understand her intended message that she forgot to buy that day’s newspaper. But in the actual circumstances where she does say ‘I forgot the paper’, ‘I forgot to buy the newspaper’ is hardly a possible interpretation because it isn’t currently relevant. (If she meant ‘I forgot to buy the newspaper’ she would be perversely and unco-operatively changing the subject without warning.)

Other relevance-based implicatures are illustrated in (21)–(22):

(21) Alice: How will Sylvie get here?
    Bella: Claude will be back from work.

On the face of it, Bella’s response doesn’t seem to be about transport for Sylvie. But assuming that Bella means to answer Alice’s question, along with other background knowledge about Claude and Sylvie, Alice can easily infer, say, that Claude will bring their car home from work and Sylvie will be able to use it. In short, Bella implicates ‘Sylvie will have the car’.

(22) Axel: Shall we invite Rupert?
    Benny: We don’t want any rows about politics.

Benny’s response must be taken as relevant to the issue of inviting Rupert to some event – Axel can easily infer that Benny thinks Rupert is likely to provoke a row about politics at the event, and Benny does not advise inviting Rupert to come. Benny implicates ‘Don’t invite Rupert’.

1.4.2 The Principle of Informativeness

The Principle of Informativeness has two clauses: (1) Give as much information as is required, and (2) Do not give more information than is required. Informativeness 2 is usually described as having rather general outcomes, in that it licences the speaker to make a statement that requires inferencing to produce the full intended message. Correspondingly, the hearer assumes that the speaker hasn’t directly stated whatever is easily filled in by inference, and
so draws the required inferences. Consider again *I forgot the paper*. In the first anecdote, Anna speaks normally when she says ‘the paper’ to refer to a copy of the current issue of a particular newspaper. In the circumstances it would have been very odd for her to have said ‘I forgot to buy a copy of today’s issue of the Christchurch Press’. By not spelling out unnecessary information, she obeys the first clause of the Principle of Informativeness.

**Informativeness 1** – ‘Give as much information as is required’ – is the basis of what is also called **scalar implicature**. Scalar implicatures typically arise with expressions denoting quantities or degrees of attributes which can be graded on some scale of informative weakness or strength. A classic scale giving rise to scalar implicature is the one shown in (23):

\[
(23) \text{ (weak) } <\text{some}, \text{most}, \text{all}> \text{ (strong)}
\]

The scale indicates that *some* is typically used to make a weaker, less informative statement than *most*, and *most* is typically used to make a weaker, less informative statement than *all*.

With a scalar implicature it is assumed that the speaker obeys Informativeness 1 and makes the strongest statement consistent with what he or she knows or believes to be the case. The speaker’s use of an expression on an information strength scale implicates the negation of any higher term on the same scale, because if a stronger version of the statement had been true, the speaker would have made the stronger statement. For example, assume that the students in a particular course have just had a test. Their teacher is asked ‘So how did the students do on the test?’ The possible answers in (24) have different scalar implicatures:

\[
(24) \begin{align*}
\text{a. Most of them passed.} \\
\text{implicature: Not all of them passed.}
\end{align*}
\]

\[
(24) \begin{align*}
\text{b. Some of them passed.} \\
\text{implicature: Not all of them passed.} \\
\text{implicature: It isn’t the case that most of them passed.}
\end{align*}
\]

\[
(24) \begin{align*}
\text{c. Two or three did very well.} \\
\text{implicature: Not more than two or three did very well.}
\end{align*}
\]

On the scale illustrated here, the relative informational strength of the expressions can also be defined in terms of entailment. ‘All the students passed’ entails ‘Most of the students passed’ and ‘Some of the students passed’ but not vice versa, so *all* is informationally stronger on the scale than *most* and *some*. Similarly, ‘Most of the students passed’ entails ‘Some of the students passed’ but not vice versa, so *most* is informationally stronger than *some*.

Further examples of scalar implicature are shown below:

\[
(25) \begin{align*}
\text{I tried to contact Don several times.} \\
\text{implicature: I didn’t manage to contact Don.}
\end{align*}
\]

\[
\text{weak } <\text{try, manage}> \text{ strong}
\]
(26) I’ve read halfway through the book.
implicature: I haven’t read any further than halfway.
weak <barely started, halfway, three-quarters through, finished> strong

(27) Diane can carry 30 pounds in her pack.
implicature: She can’t carry any more weight than 30 pounds.
weak <20 pounds, 30 pounds, 40 pounds, ... > strong

(28) (Receptionist to patient seeking an urgent appointment)
Dr Evans could fit you in tomorrow afternoon at 2.00.
implicature: He can’t see you any sooner.
weak <tomorrow at 2.00, tomorrow morning, this afternoon, in an hour, right now> strong

Example (28) shows that the strong/weak orientation of the scale for a scalar implicature may depend on the context. Here the patient wants to see the doctor as soon as possible, so the most informative response the receptionist can make is to identify the earliest available time. In a different context, as in (29) below, the relative informational strength of different time expressions is reversed, and the most informative utterance identifies the latest possible time:

(29) The machine is playing up a bit – when do you want those negatives?
I suppose first thing tomorrow would be OK.
implicature: We need the negatives no later than first thing tomorrow.
weak <this afternoon, first thing tomorrow, tomorrow afternoon, ... > strong

For the purposes of this book, the main point to remember about implicature is that not all that seems to follow from an utterance is necessarily part of the literal meaning. In some cases, such as the different interpretations of the paper in different scenarios, the pragmatic contribution of meaning is obvious. But in other cases, particularly with scalar implicature, the pragmatic nature of the implicature is not so obvious. Perhaps the most salient example of this is the implicature ‘not all’ from some, which is easily confused with an entailment. Nevertheless, it is an implicature and depends on the context, as (30) and (31) show:

(30) a. Some cast members want to see you after the show.
    b. The photographer wants some cast members for the photo.

(31) a. Some of you are working well.
    b. If some of you work solidly the mess could be cleared by tomorrow.

Here the (a) member of each pair has the expected implicature ‘not all’, but the (b) member has no such implicature. It is likely that the photographer would like the whole cast or most of the cast in the photo if possible, and if some of you can clear the mess by tomorrow, certainly most of you or all of you could clear the mess in the same time or sooner.
1.5 Other contextual factors: indexicality and anaphors

Pragmatic inference can draw on all kinds of general background knowledge which constitutes part of the wider context for the interpretation of utterances. Indexical expressions are context-dependent for their full interpretation, but not in an open-ended pragmatic way. Rather, their semantics includes a specific component which must be identified from the basic situation of the utterance. The main features of the utterance situation are the identity of the speaker, the identity of the addressee(s), and the place and time of the utterance. Common indexical expressions are illustrated in (32):

(32)  
I refers to the speaker
you refers to the addressee(s)
now refers to the time of utterance (or a time which includes the times of utterance, in the sense ‘these days’)
today refers to the day of the utterance
yesterday refers to the day before the day of the utterance
tomorrow refers to the day after the day of the utterance
past tense refers to a time before the time of utterance
future tense refers to a time later than the time of utterance
come here denotes movement toward the speaker

Other indexical temporal expressions include this week/month/year, last week/month/year, next week/month/year, and so on. The property of being defined in terms of features of the utterance situation is called indexicality. Indexical expressions are also called deictic expressions, and the corresponding property term is deixis.

Anaphors have a different kind of context-dependence, in that an anaphor picks up its reference from what was said (or written) in the context prior to the utterance. An anaphor picks up the same reference as a linguistic expression which was recently used in the context. The characteristic property of anaphors is called anaphoricity. The expression from which an anaphor picks up meaning is called the antecedent to the anaphor. Some examples are given below. The anaphor is underlined and the antecedent is in brackets.

(33)  He [grabbed the phone] and as he did so signalled frantically for a pen.
(34)  [Luisa] always thinks people are talking about her.
(35)  [Neil and Ewan] were still furious with each other.
(36)  [Jam, chocolate, tropical fruits and nuts] and other such luxuries were not seen for years.
(37)  [We] can’t imagine ourselves running a country pub, we’re not really open spaces people.
1.6 Presupposition

The issue of presupposition was raised by Strawson (1950), who pointed out that certain kinds of sentences are difficult to judge as being either true or false. Strawson observed:

Suppose someone were in fact to say to you... ‘The King of France is bald’... and went on to ask you whether you thought that what he had just said was true, or was false... I think you would be inclined to say... that the question of whether his statement was true or false simply did not arise, because there was no such person as the King of France.

Strawson said that the use of an expression like the King of France (that is, a singular noun phrase with the) presupposes the existence of its referent. The presuppositions of a statement must be satisfied for the statement to have a truth value. If the presuppositions of a statement fail, then the statement is neither true nor false – there is a truth value gap. Conversely, if the full statement does have a truth value – either true or false – then the presupposition is true. The full pattern is shown in (38):

\[(38)\]
\[
\begin{align*}
&\text{a. Statement } S \text{ presupposes presupposition } P. \\
&\text{b. If } S \text{ is true, then } P \text{ is true.} \\
&\text{c. If } S \text{ is false, then } P \text{ is true.} \\
&\text{If } \neg S \text{ is true, then } P \text{ is true.} \\
&\text{d. If } P \text{ is false, then } S \text{ is neither true nor false.}
\end{align*}
\]

Notice that the two versions of (38c) are based on the fact that if a statement $S$ is true, then the negative version $\neg S$ is false, and vice versa: If John is home is true, then John is not home is false; If John is not home is true, then John is home is false. (We will return to this point in Chapter 2.) This fact – commonly expressed as presupposition survives negation – provides the main test for presupposition as shown in (39). The comparison examples in (40) show that ordinary entailments do not survive negation:

\[(39)\]
\[
\begin{align*}
&\text{a. If } S \text{ presupposes } P, \text{ then } S \text{ entails } P \text{ and } \neg S \text{ entails } P. \\
&\text{b. The King is France is bald entails There is a King of France.} \\
&\text{c. The King of France is not bald entails There is a King of France.}
\end{align*}
\]

\[(40)\]
\[
\begin{align*}
&\text{a. Nero is a bulldog entails Nero is a dog.} \\
&\text{b. Nero is not a bulldog does not entail Nero is a dog.}
\end{align*}
\]

The fact that presupposition survives negation is also the basis of the phenomenon illustrated in (41). Either way in (41), by answering ‘Yes’ or ‘No’ to a yes-no question, the speaker is committed to the truth of the presupposition that Tom has been fiddling his taxes.
(41) Has Tom stopped fiddling his taxes yet?
  ‘Yes.’ *Tom has stopped fiddling his taxes* entails that Tom has been fiddling his taxes.
  ‘No.’ *Tom hasn’t stopped fiddling his taxes* entails that Tom has been fiddling his taxes.

If the speaker does not believe that Tom has been fiddling his taxes, he or she has to signal that the presupposition is rejected. One strategy for doing this is the ‘Hey! Wait a minute!’ routine which provides another useful diagnostic for presupposition, as illustrated below with examples from von Fintel (2004). The ‘Hey! Wait a minute!’ routine signals that the speaker’s objection relates to the assumed background of what was said, but not the actual content of the statement. This is shown in (43) where the speaker objects to the presupposition of (42). But (44) is odd, because the speaker goes on to question the actual statement that was made, not the presupposition.

(42) The mathematician who proved Goldbach’s Conjecture is a woman.
 This statement has the false presupposition that Goldbach’s Conjecture has been proved by someone.

(43) reasonable response:
 ‘Hey! Wait a minute! – I had no idea that anyone had proved Goldbach’s Conjecture.’

(44) odd response:
 ‘Hey! Wait a minute! – I had no idea that was a woman.’

Statements made in daily communication often carry presuppositions that the hearer doesn’t independently know to be true, but doesn’t object to. For example, suppose Leda says to Ariadne ‘My sister has exactly the same haircut’, which presupposes that Leda has a sister. Ariadne may not have previously known that, but the usual response is just to assume that the required presupposition is true – Ariadne just adds the fact that Leda has a sister to her general knowledge, and then the fact that that sister has a particular haircut. This is called presupposition accommodation – the hearer accommodates the presupposition by simply accepting it as a fact.

A range of different types of presupposition have been identified, and a selection of these is illustrated in the following examples.

Some determiners presuppose the total number of things of the kind mentioned. The determiner *the* in a singular NP presupposes that there is exactly one thing of the kind described (The semantics of *the* will be discussed in more detail in Chapter 6.) The determiners *both* and *neither* presuppose that there are two things of the kind described. Note that the hash sign # indicates that the marked expression is semantically anomalous:

(45) #The island of New Zealand lies to the south-east of Australia.  
 (New Zealand has three main islands.)
(46) Both twins called the wolf ‘Mama’.
(47) #Both triplets called the wolf ‘Mama’.

So-called factive verbs take a clausal argument which is assumed to be a fact (that is, true). Factive expressions also include the noun fact, and nominals derived from factive verbs.

(48) Jones knew that the pass was closed by snow entails that the pass was closed by snow.
(49) Jones didn’t know that the pass was closed by snow entails that the pass was closed by snow.

Statements that express certain kinds of focus also indicate that the non-focused content expressed in the sentence has presupposed status. The clearest examples of this are so-called it-cleft sentences as in (50) and intonational focus as in (51):

(50) It was (wasn’t) Greg who first noticed the marks on the wall presupposes that someone noticed the marks on the wall, and asserts as new information that the person in question was (wasn’t) Greg.
(51) Judith doesn’t grow LEMONS presupposes that Judith grows something, and asserts as new information that whatever she grows isn’t lemons.

So-called aspectual verbs that indicate that some kind of event continues or stops presuppose that the event has been in progress (Example (41) above also belongs in this group).

(52) James kept/continued/ceased/stopped/finished reading the paper presupposes that James was reading the paper.

Expressions of repetition presuppose that some kind of state of affairs has held previously, as illustrated below, where (53)–(55) all presuppose that Harry had previously looked at the house:

(53) Harry looked over the house again on Wednesday.
(54) Harry re-examined the house.
(55) Harry had another look at the house.

Verbs like manage and succeed presuppose that some attempt preceded the successful outcome:

(56) Jones managed to get the door open presupposes that Jones tried to get the door open.

To sum up: presupposition is a special kind of entailment, specifically one that is not cancelled by negating the statement which carries it – presupposition survives negation. Because presupposition is a kind of entailment, it is part of
the literal sense of the statement (or expression) which carries the presupposition. A presupposition attaches to a statement or sentence according to its literal meaning and doesn't depend on a particular context.

In contrast, the kind of implicature we reviewed in Section 1.4 is not entailed by what the speaker said – implicature attaches to particular utterances in specific contexts, not to sentences or statements in general. Implicature is a communicative strategy rather than a semantic property of expressions. The speaker implicates by speaking in such a way that the hearer will naturally infer the extra content.

Nevertheless, the semantic phenomenon of presupposition can be used by a speaker to indirectly convey information in a way that resembles implicature. This occurs particularly with the kind of presupposition that is likely to be accommodated by the hearer, as in (57):

(57) Oh yes, it’s quite a good little garage, I’ve had the Rolls in there and they did a good job, no complaints...

Ostensibly, the speaker is discussing the merits of a particular garage. The expression the Rolls carries the presupposition that there is a Rolls Royce, and the wider context makes it likely that this is the speaker’s car. The hearer is likely to simply accommodate this presupposition, and so without actually saying ‘I’ve got a Rolls!’ the speaker nevertheless manages to get that vital information across.

EXERCISES

Denotations

(1) ⭐
  a. What is the extension of alarm clock?
  b. What is the extension of Cairo?
  c. What is the intension of fishknife?
  d. What is the truth set for Jones has a new game console?

(2) ⭐⭐
  a. What is the intension of Ludwig Beethoven?
  b. What is the extension of phoenix?
  c. What is the intension of phoenix?

Truth conditions – a new point

(3) ⭐

Recall that possible worlds theory analyses the meaning of a sentence as its truth set, or the set of all possible worlds in which the sentence is true. This doesn’t always work out. Can you identify the problem for the groups of sentences below? (Hint: What is the truth set for each sentence?)
(i) a. That tigress is a female.
   b. Every circle in the pattern was round.
   c. Either God exists or God doesn’t exist.
(ii) a. Two plus two is five.
   b. Spain is bigger than Iceland and Iceland is bigger than Spain.

Implicature

(4) *
In each pair of utterances below, the second utterance carries a standard kind of implicature. For each example, identify the implicature (or implicatures) and the main Principle involved (Relevance, Informativeness 1, Informativeness 2).

a. Ally: Do your children eat greens?
   Britt: Well, David eats spinach.

b. Abe: Did you fix the blind?
   Brian: I tried to.

c. Alicia: Do you love me?
   Bob: I’m very fond of you.

d. Aelfric: Did you stack the dishes and load the washing machine?
   Beowulf: I’ve stacked the dishes.

e. Abdul: Let’s try that new French restaurant.
   Saladin: I’m on a low-fat diet.

(5) **
In the dialogue below, see if you can identify the implicatures (if any) for each utterance. The utterances are lettered for convenience but the whole series is a dialogue, so each utterance is a response to the one before. One Principle underlies almost all the implicatures here – can you say what it is?

a. Adam: I need a hand to get this piano upstairs.
b. Barry: Oh... my practice starts in ten minutes.
c. Adam: Mmm... I wonder if Jim next door is home.
d. Barry: The Volkswagen is in the drive.
e. Adam: Do you think it’s a bad time to ask?
f. Barry: Well, he really hates missing the six o’clock news.
g. Adam: I’ll wait till you get back.

Anaphors

(6) *
Identify the anaphoric expressions and their antecedents in the passage below.

Clive and Marcia had themselves photographed first thing on Tuesday, and in the afternoon of the same day their secretary drew up a list of things to do. Ordering the passports, arranging visas, buying travellers’ cheques and other such matters were Marcia’s province, while Clive shopped busily for suntan lotion, enjoyable trashy
paperbacks and those stick-on patches for seasickness. Clive bought mostly spy thrillers to read, which annoyed Marcia as she preferred murder mysteries. When Marcia was organizing the visas she found she couldn’t get herself one for Burma, although Clive still wanted to go there. Nevertheless, none of this depressed their holiday mood; Marcia became more and more excited and so did Clive.

**Indexicality**

(7) ✶
Identify all the indexical expressions in the passage below, and state how each one is interpreted according to the utterance context.

When I saw John the other day he had just come out of the tube station. He was standing right here in front of the doorway – I nearly ran into him. He said ‘Oh, it’s you’ in the most peculiar way – I thought he was annoyed that I knew he had been in there.

**Presupposition**

(8) ✶
What are the presuppositions, if any, of the following sentences?

a. Mandy didn’t finish her dinner.
b. Clive enjoyed the party immensely.
c. Edward realized that he knew Sally.
d. Latoya was delighted that she got her license.
e. Mandy is looking forward to her trip.
f. John didn’t stop laughing.
g. She knows they’re lovers.
h. Jones commended Louis for publishing the pamphlet.
i. Jones paid Louis for publishing the pamphlet.
j. Jones accused Louis of publishing the pamphlet.
k. Jones is going to Paris and he’s thrilled that he’s flying on Concorde.
l. Many people who have been kidnapped by aliens have published their experiences.
m. The truck began to roll faster on the slope.

(9) ✶✶
What are the presuppositions, if any, of the following sentences?

a. Even John couldn’t get tickets.
b. Even John got good tickets.

(10) ✶✶✶
Consider the examples below: (a) seems to convey that the terrace and the conservatory are hot, and (b) that the Pompidou building and the National Theatre are ugly. But (c) and (d) do not convey, respectively, that Sam is old or young. Is the effect in (a) and (b) a presupposition? Use the diagnostic tests to check this.

a. In the afternoons the terrace is hotter than the conservatory.
b. The Pompidou building is uglier than the National Theatre.
c. Sam is older than Annette.
d. Sam is younger than Annette.
Portner (2005) Chapter 1 is an introduction to truth conditions. Carston (1995) is an accessible overview article on truth conditional semantics.

The field of pragmatics is large and complex, with increasing interest in and connections to cognitive science. For the issues addressed here (most relevant to the semantic concerns of this book), Levinson (1983) is a good introductory textbook covering traditional ideas in pragmatics, including Grice’s theory of implicature. A more recent introduction to implicature in a Relevance Theory framework is Blakemore (1992). Relevance Theory explores the cognitive aspects of implicature and inferencing.

The most recent authoritative introduction to pragmatics is Huang (2007) – this text is more advanced but accessible.
2.1 Representations for meanings

To discuss the meanings of sentences and other expressions, we need a way to represent them. Sentences written in ordinary writing are not reliable representations of their meanings, as written forms do not always capture sameness and difference of meaning, for example:

(1) a. Rameses ruled Egypt.
    b. Egypt was ruled by Rameses.
    c. Visiting relatives can be boring.
    d. Visiting relatives can be boring.

Sentences (1a, b) have different written forms but the same truth condition. Sentences (1c, d) have the same written form but different meanings – one means ‘Relatives who are visiting one can be boring’ and the other means ‘It can be boring to visit relatives’. So we need to represent meanings directly, and for this we shall use a notation based on logic.

Logic is chiefly concerned with relationships between meanings, particularly the meanings of declarative sentences, in processes of reasoning. The meaning of a declarative sentence – the kind that can be used to make a statement and can be true or false – is a proposition. To explore how propositions are related to each other in reasoning, logic analyses their inner structure. Propositional logic analyses certain ways of combining propositions to form complex propositions. The expressions which are used to combine propositions are the connectives, discussed in Section 2.2. Predicate logic analyses the inner structure of simple propositions, which are formed of predicates and their arguments, discussed in Section 2.3. The logical quantifiers are discussed in Chapter 3.
2.2 The logical connectives

The logical connectives combine propositions to form more complex propositions in ways which correspond to certain uses of and, or, and if. We begin with conjunction.

2.2.1 Conjunction

Conjunction is expressed by certain uses of and, illustrated below:

(2) Moira left and Harry stayed behind.

In this sentence and joins the two sentences Moira left and Harry stayed behind. The whole sentence is true if both the joined sentences are true, and false otherwise. That is, it is false if they both left, or both stayed behind, or if Harry left and Moira stayed behind. This pattern holds for any two sentences joined by and: the truth value for the whole sentence depends on the truth values for the parts.

(3) a. Alfred sings alto and Paul sings bass.
   b. There were lights showing and the door stood open.
   c. The airport was closed and all ferry trips were cancelled.

This general pattern is characteristic of logical connectives, which are truth-functional: the truth value for a complex proposition formed with a truth-functional connective can be calculated simply from the truth values of the joined propositions, without referring to the content of the propositions.

Most natural language expressions for connecting sentences are not truth-functional. The difference can be illustrated with because, as in (4):

(4) a. Jill was late for work because her car broke down.
   b. Jill was late for work because she was caught in a traffic jam.

Suppose that Jill was late for work, her car broke down, and she was caught in a traffic jam, so the component propositions in (4a) and (4b) are true. In fact, Jill’s car broke down long before she had to leave for work so she took a taxi, and if it hadn’t been for the traffic jam she would have arrived on time, so (4a) is false and (4b) is true. We can’t calculate the truth or falsity of (4a, b) simply by knowing whether or not the component propositions are true. We have to know the content of the propositions combined by because to judge whether or not the circumstances described in the because-proposition really caused the circumstances described in the other proposition. In short, the truth of a proposition with because depends on more than just the truth or falsity of the propositions which are combined, so because is not truth-functional.

Propositional logic deals with truth-functional expressions. Four of these, including conjunction, are connectives, because they connect two propositions. Propositional logic also deals with negation because it is truth-functional as we
shall see below, although it does not combine propositions and therefore is not strictly a connective.

The conjunction connective is written with the symbol & or \( \land \). The symbol & is used in this book. Propositions are represented by **propositional variables**, traditionally \( p \) and \( q \), with \( r \) and \( s \) added if needed. Complex propositions formed by conjunction are also called conjunctions. Conjunctions in general are represented by the formula schema \( p \& q \), where \( p \) and \( q \) stand for any proposition.

We can list all the possible combinations of truth values for \( p \) and \( q \) and give the corresponding truth value for the conjunction \( p \& q \). In effect, this defines the meaning of the conjunction connective. Such a definition is given in the form of a table called a **truth table**.

(5) Truth table for conjunction

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>( p &amp; q )</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>T</td>
<td>T</td>
</tr>
<tr>
<td>T</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>F</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>F</td>
<td>F</td>
<td>F</td>
</tr>
</tbody>
</table>

The order in which \( p \) and \( q \) are expressed makes no difference to the truth value. The propositions \( p \& q \) and \( q \& p \) are **equivalent**: \( p \& q \) always has the same truth value as \( q \& p \), for any combination of truth values for \( p \) and \( q \). This doesn’t hold for all uses of the word *and*, but it does hold for the examples in (2) and (3), repeated here:

(6) a. Moira left and Harry stayed behind.
   Harry stayed behind and Moira left.

b. Alfred sings alto and Paul sings bass.
   Paul sings bass and Alfred sings alto.

c. There were lights showing and the door stood open.
   The door stood open and there were lights showing.

d. The airport was closed and all ferry trips were cancelled.
   All ferry trips were cancelled and the airport was closed.

The conjunction connective only connects propositions, expressed by sentences, but the word *and* can connect a wide range of types of expression. Some of the sentences in which *and* connects expressions smaller than sentences can be analysed as conjunction reduction, illustrated below. **Conjunction reduction** is a linguistic abbreviation for what is logically a conjunction of whole propositions.

(7) a. [Moira and Harry] left.
   b. Tom saw [Moira and Harry].
   c. Moira was [changing her spark plugs and listening to talkback radio].
In (7a) and (7b) *and* connects two names, while in (7c) two verb phrases are joined. Sentences like these can be analysed as instances of linguistic abbreviation:

(8) a. *Moira and Harry left* expresses ‘Moira left and Harry left’.
     c. *Moira was changing her spark plugs and listening to talkback radio* expresses ‘Moira was changing her spark plugs and Moira was listening to talkback radio.’

Not all uses of *and* to join non-sentential expressions can be analysed as conjunction reduction. The commonest exception is the use of *and* to form a complex noun phrase which refers to a group, as in (9a–c):

(9) a. Sally and Harry met for lunch.
     b. Sally, Harry, Jeff and Buzz met for lunch.
     c. Harry, Jeff and Buzz surrounded Charles.
     d. The gang met for lunch.
     e. The forest surrounded the castle.

At first sight it looks as if (9a) could be analysed as a conjunction of propositions, ‘Harry met Sally for lunch and Sally met Harry for lunch’, but the other examples indicate that this won’t work generally. In particular, (9d) indicates that it is the group as a whole which meets, and so the noun phrase *Sally, Harry, Jeff and Buzz* in (9b), for example, should be interpreted as referring to the whole group of people. Similarly, (9c) cannot be understood to mean ‘Harry surrounded Charles and Jeff surrounded Charles and Buzz surrounded Charles’, because ‘Harry surrounded Charles’ doesn’t make sense – the three people as a group surrounded Charles. In these instances the word *and* is not a connective at all as it doesn’t join sentences, but forms a complex noun phrase referring to a group, which as a whole performs the described action. (This kind of group reference is explored further in Exercises 10–12 in Chapter 6.)

### 2.2.2 Negation

As above, negation is generally included with the logical connectives because it is truth-functional, being defined by a truth table. Simply, negation combines with a single proposition to reverse its truth value. The two common symbols for negation are ¬ and ~. This book uses ~.

(10) Truth table for negation

<table>
<thead>
<tr>
<th>P</th>
<th>~P</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>F</td>
<td>T</td>
</tr>
</tbody>
</table>

Negation is expressed in several ways in English, most commonly by *not* or *n’t* after the first auxiliary verb. For example, if *p* represents the proposition
expressed by *Moira left*, then \( \sim p \) is expressed by *Moira didn’t leave*. If ‘Moira left’ is true, then ‘Moira didn’t leave’ is false, and if ‘Moira didn’t leave’ is true, then ‘Moira left’ is false.

### 2.2.3 Disjunction

The **disjunction** connective corresponds to the use of the word *or* which is commonly glossed as ‘and/or’ or described as **inclusive disjunction**. The symbol for disjunction is \( \vee \). A logical disjunction is true if either or both of the combined propositions is true.

(11) Truth table for disjunction

\[
\begin{array}{ccc}
 p & q & p \vee q \\
 T & T & T \\
 T & F & T \\
 F & T & T \\
 F & F & F \\
\end{array}
\]

Where two propositions joined by disjunction have some content in common, the sentence expressing the proposition (with the word *or*) is usually abbreviated in the form of **disjunction reduction**, much like conjunction reduction. For example, *That job will take two or three tins of paint, depending on the weather* is interpreted as ‘That job will take two tins of paint or that job will take three tins of paint, depending on the weather’.

Inclusive disjunction (*and/or*) corresponding to logical disjunction is illustrated below:

(12) The prerequisite for FLWR211 is HORT112 or HORT113.

‘To enrol in FLWR211 you must have already passed HORT112 or HORT113 (or both)’.

Exclusive disjunction is illustrated in (13):

(13) The agent arrived in Berlin on the 9.25 or the 11.10.

(‘The agent arrived in Berlin on the 9.25 or the agent arrived in Berlin on the 11.10’)

Here one or the other of the connected sentences is understood to be true, but not both. The difference between inclusive and exclusive interpretations of *or* may be pragmatic. In examples like (12) and (13) we use general knowledge to decide how *or* is to be interpreted (see also Exercise 7).

The exclusive disjunction use of *or* (‘either but not both’) can be represented by adding the qualification ‘but not both’ to logical disjunction, for example:

(14) \( p = \text{you take the money} \)

\( q = \text{you take the bag} \)

Either you take the money or you take the bag = \( (p \vee q) \& \sim(p \& q) \)
Note here that brackets are used to indicate which proposition, simple or complex, is combined by a particular connective or combined with negation. The disjunction $p \lor q$ is itself the first part of the whole conjunction. Negation combines with the conjunction $p \land q$, then the whole negative proposition $\sim (p \land q)$ is the second part of the whole conjunction.

### 2.2.4 The material implication connective

Conditionality is mainly expressed by certain uses of *if* or *if ... then*. Sentences with *if* are called *conditional sentences* or conditionals for short. There are two truth-functional connectives corresponding to conditionals, the material implication connective and the biconditional connective, which is discussed in the next section. As we shall see, these two connectives only partly fit the usual ways we understand *if* sentences.

The material implication connective is represented by the symbol $\rightarrow$ or $\supset$. This book uses $\rightarrow$. The proposition $p$ in $p \rightarrow q$ is the *antecedent*, and $q$ is the *consequent*. In a conditional sentence the antecedent is the sentence to which *if* is attached, although it may appear first or second in the whole sentence.

(15) a. antecedent  consequent
    If Marcia invited John (then)  he’ll go.

b. consequent  antecedent
    John will go  if Marcia invited him.

The truth table for material implication is in (16):

(16) Truth table for material implication

<table>
<thead>
<tr>
<th>$p$</th>
<th>$q$</th>
<th>$p \rightarrow q$</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>T</td>
<td>T</td>
</tr>
<tr>
<td>T</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>F</td>
<td>T</td>
<td>T</td>
</tr>
<tr>
<td>F</td>
<td>F</td>
<td>T</td>
</tr>
</tbody>
</table>

Using the example in (15) *If Marcia invited John, he’ll go*, the lines of the truth table give these truth values:

(17) $p = \text{Marcia invited John}$
$q = \text{John will go}$
$p \rightarrow q = \text{If Marcia invited John, he’ll go}$

- line 1
  Marcia did invite John and John will go: the implication is true
- line 2
  Marcia did invite John, but actually John won’t go: the implication is false
Marcia didn’t invite John, but he will go anyway: the implication is true

Marcia didn’t invite John and John won’t go: the implication is true

Lines 1 and 2 give the results we would expect from the ordinary use of *if*: Line 3 seems odd. If John will go (to some understood destination) whether Marcia invited him or not, why bother to say ‘if Marcia invited John’ at all? All that is communicated here is ‘John will go’. In fact, an utterance of *If Marcia invited John, he’ll go* is more likely to be intended to mean ‘If Marcia invites John he’ll go, but not otherwise’ – explicitly, ‘If Marcia invited John he’ll go, and if she didn’t invite him, he won’t go’. On this reading the whole sentence on line 3 should be false. This interpretation of *if* is more like the biconditional connective, to be reviewed in Section 2.2.5.

The apparent mismatch arises because *if* is commonly not simply truth-functional in actual use. Given that material implication is truth-functional, the truth of an implication proposition depends only on a certain combination of truth values for the contained propositions, and the actual content or subject matter of those propositions is irrelevant. Logically, (18) expresses a perfectly fine (and true) implication, but it is odd as a conditional sentence:

\[
\text{(18) If the number 1960 is divisible by 5 then 1960 was a leap year.}
\]

<table>
<thead>
<tr>
<th>Antecedent (1960 is divisible by 5)</th>
<th>True</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consequent (1960 was a leap year)</td>
<td>True</td>
</tr>
<tr>
<td>Implication</td>
<td>True</td>
</tr>
</tbody>
</table>

But many of us would dispute the truth of (18), because we don’t calculate leap years by dividing by five. The problem here is that we frequently use *if... then* to express some causal relationship between the antecedent and consequent – the antecedent describes some event or state of affairs which causes what is described by the consequent – in other words, the consequent describes the consequences. Sentence (18) reads most naturally as stating that the status of 1960 as a leap year depends on the year’s number being divisible by five, whereas in fact divisibility by four is the criterion for leap years. The extra causal connection – that the antecedent situation causes the consequent situation – is generally classed as a pragmatic inference under the Principle of Relevance or R-implicature (see Section 1.4).

A conditional statement which is pragmatically interpreted as expressing a causal relation must still satisfy the truth table for implication: if the antecedent is true the consequent must also be true. For example, *If the number 1960 is divisible by 4 then 1960 was a leap year* is consistent with the causal interpretation of *if*. In addition, given that the antecedent is true, the conditional statement is true only if the consequent is also true and 1960 was a leap year – if 1960 was not a leap year the conditional is false. That is, the causal meaning associated with *if* is extra content added to the meaning of material implication.
There is a common rhetorical use of \textit{if... then} that fits well with the material implication analysis, requiring no causal or commonsense connection between the sentences, as illustrated in (19):

(19) If that's a genuine Picasso then the moon is made of longlife food product.

\begin{itemize}
  \item p = that's a genuine Picasso
  \item q = the moon is made of longlife food product
\end{itemize}

Recall from Chapter 1 that normal communication is co-operative, and assume that this includes the assumption that the speaker won't deliberately lie. So the hearer will assume that the whole statement in (19) is offered as true. The rhetorical device requires that the consequent be obviously false. This gives the combination of values:

(20) $\begin{array}{ccc}
      p & q & p \rightarrow q \\
      \ T & \ F & \ T \\
      \ F & \ T & \ F \\
    \end{array}$

Checking the truth table for implication (see (16) above) we see that this combination of truth values occurs only on line 4, where the antecedent is false. So this rhetorical device is used to convey that the antecedent is false. Here, (19) is used to convey that that's not a genuine Picasso. Routines of this form include the cliché \textit{if... I'll eat my hat}.

\subsection*{2.2.5 The biconditional connective}

The biconditional connective, represented by the symbol $\leftrightarrow$, expresses the relation of material equivalence between propositions. Two propositions are materially equivalent if they have the same truth value, either both true or both false. Accordingly, the biconditional $p \leftrightarrow q$ is true if $p$ and $q$ have the same truth value, and otherwise false.

(21) Truth table for biconditional connective

\begin{itemize}
  \begin{array}{ccc}
      p & q & p \leftrightarrow q \\
      \ T & \ T & \ T \\
      \ T & \ F & \ F \\
      \ F & \ T & \ F \\
      \ F & \ F & \ T \\
    \end{array}
\end{itemize}

A biconditional interpretation of \textit{if} is illustrated in (22), where the rider ‘but not otherwise’ is understood:

(22) If you kick me again I’ll punch you.

The biconditional interpretation of \textit{if} can be analysed as pragmatically derived from the material implication interpretation. Suppose that $p = \text{You kick me}$
again and \( q = I \) punch you, and the truth condition for if is material implication as in (16). As we saw above, a causal (and temporal) connection between the events is added pragmatically by R-implicature (see Section 1.4). That is, the kicking is understood to happen before the punching, and the kicking also causes the punching, as the punching is in response to the kicking. Now the added interpretation that the kicking causes the punching leads to the further inference that the speaker won’t just punch the hearer anyway without cause. So the hearer understands:

\[
(23) \quad (p \to q) \land \neg (\neg p \land q)
\]

If you kick me I’ll punch you ... but not otherwise

Specifically, the hearer can infer that line 3 of the truth table for material implication doesn’t apply. The difference on line 3 distinguishes material implication from the biconditional.

\[
\begin{array}{cccccc}
\text{p} & \text{q} & p \to q & \text{p} & \text{q} & p \iff q \\
\text{line 1} & T & T & T & T & T \\
\text{line 2} & T & F & F & T & F \\
\text{line 3} & F & T & T & F & F \\
\text{line 4} & F & F & T & F & T \\
\end{array}
\]

line 1 You kick me and I punch you  
line 2 You kick me and I don’t punch you  
line 3 You don’t kick me and I punch you anyway  
line 4 You don’t kick me and I don’t punch you

### 2.3 Predicates and arguments

The internal structure of the simplest kind of proposition, an **atomic proposition**, consists of a predicate and its argument or arguments. We begin with so-called two-place predicates as an illustration.

\[
\begin{array}{c}
\text{a. Brigitte is taller than Danny} \\
\text{b. Alex is Bill’s henchman.} \\
\text{c. Fiji is near New Zealand.} \\
\end{array}
\]

All of these sentences express a relationship between two entities. If we take out the expressions which refer to entities, we are left with the part that expresses the relationship – this part expresses the **predicate**.

\[
\begin{array}{c}
\text{a. } \ldots \text{ is taller than } \ldots \\
\text{b. } \ldots \text{ is } \ldots \text{'s henchman} \\
\text{c. } \ldots \text{ is near } \ldots \\
\end{array}
\]

In each of these sequences there is one main word which on its own indicates the nature of the relationship, or the content of the predicate. In the notation to
be used here the symbol for the predicate is based on the main word, omitting tense, copula *be*, and some prepositions. The entities bound in a relationship by the predicate are its arguments, referred to in these examples by names. By convention, names are represented by lowercase letters. The formulae for the sentences in (25) are:

(27)  TALLER(b, d)
      HENCHMAN(a, b)
      NEAR(f, n)

These examples illustrate some of the main points about predicates.

First, predicates are semantically ‘incomplete’ if considered in isolation. It isn’t possible to paraphrase or explain the meaning of one of these predicates without including the notion of there being two entities involved in any situation where the predicate applies.

Second, each predicate has a fixed number of arguments. These predicates must have exactly two arguments to form a coherent proposition — no more and no fewer — hence they are two-place predicates. The argument ‘slots’ are part of the predicate’s meaning.

Predicates are commonly used elliptically in natural language, with one of the arguments not explicitly mentioned. For example, one might say simply ‘Brigitte is taller’ or ‘Alex is a faithful henchman’. But the second, unmentioned argument in elliptical utterances like these is still understood in the expressed proposition. If Danny is a subject of conversation, ‘Brigitte is taller’ can be interpreted to mean ‘Brigitte is taller than Danny’. In another context, it may be interpreted to mean that Brigitte is taller than she used to be. It isn’t possible to be taller in isolation without being taller than some comparison standard, and it isn’t possible (in modern English) to be a henchman without being someone’s henchman. The second argument is still understood to be present in the proposition expressed.

The elliptical use of predicates found in natural language is not well-formed in standard logical notation, and both the arguments of a two-place predicate must be represented in a logical formula. Although (28a, b) below can communicate complete propositions (because we can usually understand from the context what elements have been ellipsed), (28c, d) are not well-formed, and don’t express propositions. Logical formulae themselves cannot be elliptical. (The asterisk before an example indicates that it is ill-formed.)

(28)  a. Brigitte is taller.
      b. Alex is a faithful henchman.
      c. *TALLER(b)
      d. *HENCHMAN(a)

The unmentioned argument is usually clearly identified from the context, but even if no context is supplied to give this information, the argument position can be filled by a general term, for now, *someone* or *something*, as in (29).
The third point about predicates is that the order of the arguments in the formula is significant. Generally (but not always) the order of arguments in a logical representation is taken from the order of the corresponding expressions in the sentence, for example:

a. Brigitte is taller than Danny.
   TALLER(b, d)

b. Danny is taller than Brigitte.
   TALLER(d, b)

The predicates we considered in Chapter 1, such as dog, brown and barks, are all one-place predicates. The most basic subject+predicate sentence of traditional grammar contains a one-place predicate, with the subject of the sentence expressing its single argument, as in (31):

a. Zorba was Greek.
   GREEK(z)

b. Moby Grape is purple.
   PURPLE(m)

c. Perry is a lawyer.
   LAWYER(p)

d. Cyrus coughed.
   COUGH(c)

Note that one- and two-place predicates can be expressed by a range of lexical categories, as illustrated in (32):

adjective 1-place: TALL PURPLE GREEK

preposition 2-place: NEAR ON BESIDE

noun 1-place: LAWYER DOG CORACLE

verb 1-place: COUGH JUMP

Three-place predicates (and four-place predicates, if there are any) are expressed by verbs, and perhaps by nouns derived from verbs. Three-place predicates are commonly expressed by so-called double object verbs, for example:

a. Richard gave Liz a diamond. (double object)
b. Richard gave a diamond to Liz.
c. Marcia showed Clive the ad. (double object)
d. Marcia showed the ad to Clive.

other three-place verbs: tell, teach, send, pass, offer, etc.

Although the two sentences in each pair have different word order, they have the same meaning. For examples like these, one word order must be chosen as
the basis for the order of arguments in the logical representation – in this case, the order in (33b, d) is used, and the formulae are as in (34):

(34)  
   a. GIVE(r, a diamond, l) (for (33a, b)
   b. SHOW(m, the ad, c) (for 33c, d)

Here two of the arguments are expressed by noun phrases which are not names – a diamond and the ad. Noun phrases like these are analysed in more detail in Chapter 3 and Chapter 6.

There may not be any real four-place predicates in natural language, although in principle there is no limit on how many arguments a predicate can have. The reason for uncertainty over four-place predicates is covered in the next section. A couple of likely candidates for four-place predicates are buy and sell.

(35)  
   a. Marcia sold the car to Clive for $200.  
       SELL(m, the car, c, $200)
   b. Clive bought the car from Marcia for $200.  
       BUY(c, the car, m, $200)

2.3.1 Predicates, verbs and the number of arguments

As we saw earlier, every predicate has a fixed number of arguments which must be present in a well-formed proposition, and accordingly, a logical form must represent all the arguments of each predicate. Natural language allows for elliptical forms like those in (28a, b), where an argument of the predicate need not be expressed in the sentence, although its presence in the proposition is still understood. Other examples of ellipsis are in (36):

(36)  
   a. Will you pour out?  (the tea)
   b. I gave at the office.  (money, to your charity)
   c. Add meat to pan and sauté lightly. (you, the meat)

On the other hand, there is a general axiom in syntactic theory that all syntactic arguments of verbs (and possibly of other predicates) are obligatory, and must be expressed in a well-formed sentence. Ellipsis is a special exception to this general rule. This principle may be used to test whether or not a phrase is an argument of the verb, for example:

(37)  
   a. Al put the groceries away/on the bench.
   b. #Al put the groceries.

A sentence with the verb put requires a locative phrase expressing where something is put. Example (37b) lacks a locative expression and is ill-formed, in contrast to (37a). This is generally taken as evidence that the locative expression is obligatory with put and therefore is an argument of put. Roughly, if an expression cannot be omitted without making the sentence ill-formed (and
there is not an obvious ellipsis with specific content known from the context) then the expression is an argument of the predicate.

The general principle that the syntactic arguments of verbs are obligatory has a number of apparent counterexamples falling into two main groups.

The first group, as we have seen, are elliptical sentences. A possible syntactic strategy for some of these sentences is to include a sort of ‘silent pronoun’ (pro in (38) below) in the syntactic structure of the sentence to fill the argument slot. This allows the obligatory argument principle to be maintained, as the silent pronoun counts as an expression of the argument in question, even though it is not pronounced. What it refers to is provided by the context, as is commonly the case with pronouns like he, she, they, etc.

\[
\begin{align*}
(38) & & \text{Sentence} & & \text{Verb phrase} \\
& & \textit{jacob will tell Laura} = & & \textit{jacob will tell Laura pro} \\
& & \textit{pro} & & \textit{refers to what jacob will tell Laura, identified from context}. \\
\end{align*}
\]

Counterexamples of the second kind show what is called variable adicity. The adicity of a predicate is the number of arguments it takes, derived from the terms monadic (= one-place), dyadic (= two-place), triadic (= three-place), and so on. Verbs with variable adicity seem to have variable numbers of arguments in different sentences, for example:

\[
\begin{align*}
(39) & & \text{a. They showed the film to the censor on Tuesday.} & & 3 \\
& & \text{b. They showed the film on Tuesday.} & & 2 \\
& & \text{c. He served the soup to the guests first.} & & 3 \\
& & \text{d. He served the soup first.} & & 2 \\
& & \text{e. He served the guests first.} & & 2 \\
& & \text{f. She wrote a letter.} & & 2 \\
& & \text{g. She wrote him a letter.} & & 3 \\
\end{align*}
\]

Discussing data like these, linguists refer informally to optional arguments, although strictly speaking an argument is obligatory by definition. Indispensability is part of what it is to be an argument.

An alternative is to maintain that all arguments are indeed obligatory, and that the sentence groups above do not contain the same verb – for example, the verb show in (39a), which has three arguments, is not the same as the two-argument verb show in (39b). In traditional syntactic theory the different variants of verbs like these are represented in the lexicon with different sets of arguments. We will adopt this approach here, so that, for example, (39a) will be represented as (40a), and (39b) as (40b):

\[
\begin{align*}
(40) & & \text{a. SHOW(they, the film, the censor)} \\
& & \text{b. SHOW(they, the film)} \\
\end{align*}
\]

Strictly speaking we should use different symbols for the two predicates SHOW₁ and SHOW₂, but for convenience we will continue to use the normal spelling of the word-form.
Now consider again the question of buy and sell (members of the so-called exchange verbs) and whether or not there are four-place predicates.

(41)  
\begin{align*} 
a. & \text{Marcia sold the car to Clive for$200.} 
\hspace{1cm} b. & \text{Marcia sold the car for$200.} 
\hspace{1cm} c. & \text{Marcia sold the car to Clive.} 
\hspace{1cm} d. & \text{Marcia sold the car.} 
\end{align*}

(42)  
\begin{align*} 
a. & \text{Clive bought the car from Marcia for$200.} 
\hspace{1cm} b. & \text{Clive bought the car for$200.} 
\hspace{1cm} c. & \text{Clive bought the car from Marcia.} 
\hspace{1cm} d. & \text{Clive bought the car.} 
\end{align*}

Here the semantic and syntactic indications diverge. Semantically, an event cannot be a buying or a selling without a buyer, a seller, the thing bought/sold, and the payment, so semantically it appears that exchange predicates are four-place predicates. But syntactically the verbs buy and sell only require two arguments as in (41d) and (42d). Notice that these sentences are not elliptical: for example Marcia sold the car can be understood as a complete proposition without knowing from the context who she sold it to or for how much. Compare this with the elliptical Marcia arrived late, which cannot be fully understood without knowing from context where Marcia arrived — semantically arrive requires a destination argument.

Problems like these show that the distinction between arguments and non-arguments is not always clear-cut, and in particular, that there are argument-like expressions which nevertheless appear to be syntactically optional. The issue of so-called optional arguments in syntax is complex and not resolved. For our purposes, we will assume that a semantically necessary argument (according to our best intuitions) is an argument. There are unclear cases.

On the other hand, there are several types of expression that are easily identified as non-arguments, or adjuncts in syntactic terms. These include all kinds of adverbials, such as expressions of Time, Manner, and Place, and also Reason and Purpose, as illustrated in (43).

(43)  
Seymour will slice the salami \underline{\text{carefully}} \underline{\text{in the kitchen}} \underline{\text{tomorrow}}
\underline{\text{to make the canapés}} \underline{\text{because he thinks Sally cuts it too thick.}}

The atomic proposition here – that is, the main predicate and its arguments – is ‘Seymour sliced the salami’:

(44)  
\text{SLICE(s, the salami)}

At present we omit the tense marker will, the manner adverb carefully, the locative adverbial in the kitchen, the temporal adverb tomorrow, the adverbial
clause of purpose to make the canapés, and the adverbial clause of reason because he thinks Sally cuts it too thick. We will deal with tense in Chapter 9 and adverbials in Chapter 11. Properties of arguments are also discussed further in Chapter 10.

2.3.2 Sentences as arguments

All the arguments in the discussion so far have been expressed by noun phrases, but arguments can also be expressed by sentences themselves, as in (45):

(45) a. Clive said something
    SAY(c, something)

b. Clive said [that he gave the car to Marcia]
    SAY(c, GIVE(c, the car, m))

c. Clive thinks [the earth is flat]
    THINK(c, FLAT(the earth))

In (45b, c) the proposition expressed by the embedded sentence is the second argument of the main verb – the proposition is what is said or what is believed. (Sentences about thinking and believing are discussed further in Chapter 7.)

The clearest examples of sentential arguments are found with verbs, but plausibly members of other word classes can also have sentential arguments.

(46) a. Shirley was proud [of the new car]

b. Shirley was proud [that she graduated]

c. Shirley was proud [to be Miss Lada 1993]

In (46a) it seems that the new car, the source of Shirley’s pride, is the second argument of proud. In (46b, c) the embedded sentence also expresses the source of pride, the second argument of proud, and so the propositions can be represented as in (47):

(47) a. PROUD(s, the new car)

b. PROUD(s, GRADUATE(s))

c. PROUD(s, MISS LADA 1993(s))

A sentential argument may also be the only argument of the main predicate in a sentence, for example:

(48) a. [That Clive drove the car] is obvious

b. It is obvious [that Clive drove the car]

c. OBVIOUS(DRIVE(c, the car))
2.3.3 Path arguments

Generally prepositions such as in, on, beside, and so on express relations and are analysed as two-place predicates, as in (49):

(49)  
   a. Abel is in the garage. \(\text{IN}(a, \text{the garage})\)  
   b. The book is about turtles. \(\text{ABOUT}(\text{the book, turtles})\)

However, this analysis does not easily extend to sentences describing motion along a path, where the prepositional phrase names the path.

(50)  
   a. Jonah slithered \textit{down the whale’s throat}.  
   b. Eberhart dashed \textit{into the shed}.  
   c. Corey ambled \textit{towards the beach}.

I said earlier (see discussion of Examples (25)–(27)) that logical representations omit expressions that are mainly required for syntax, such as \textit{than} after a comparative adjective, or \textit{to} in \textit{He gave the house to the nation}. This approach doesn’t work for (50), because the prepositions \textit{down}, \textit{into}, and \textit{towards} contribute to the atomic proposition and are not simply required for syntactic reasons.

In fact, the whole prepositional phrase behaves like an argument. An event of \textbf{translocation} (moving to another location, not just moving on the same spot like \textit{shiver} or \textit{shimmy}) requires the path followed by the thing moving, and this is reflected in syntax. Generally translocation verbs select a path phrase, and if it is omitted it must be by ellipsis, where the content is supplied by context.

(51)  
   a. #Jonah slithered.  
   b. #Eberhart dashed.  
   c. #Corey ambled.

We need a way to represent the path argument, and this suggests that prepositions are not all of the same kind. Some prepositions are two-place predicates, as in (49) above, while others are part of a path phrase and do not express a two-place relation. At this stage we will not analyse the internal structure of paths, but can represent path phrase arguments as illustrated in (52):

(52)  
   a. \textsc{slither}(j, \textit{down the whale’s throat})  
   b. \textsc{dash}(e, \textit{into the shed})  
   c. \textsc{amble}(c, \textit{towards the beach})

Accepting that prepositions are not always two-place predicates, we can now also use the whole prepositional phrase to express the location argument with \textit{put} verbs, as in (53):

(53)  
   Jones put the photos in the drawer. \(\text{PUT}(j, \text{the photos, in the drawer})\)
The logical connectives

(1) * Assuming that p is true, q is false and r is true, calculate the truth values for the following formulae.

Here is an example: \(-(p \& q) \lor (r \rightarrow q)\)

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a. \((p \& q) \rightarrow q\)
b. \((p \lor (q \lor r)) \rightarrow (p \& (q \lor r))\)
c. \((p \& r) \leftrightarrow (r \lor q)\)
d. \((p \rightarrow q) \& (p \& r)\)
e. \((p \lor q) \leftrightarrow (r \rightarrow q)\)
f. \((p \lor q) \leftrightarrow (r \rightarrow q)\) \lor \neg r\)
g. \(r \rightarrow ((\neg q \& p) \lor ((q \rightarrow r) \lor (\neg r \rightarrow p)))\)
h. \(((r \lor q) \leftrightarrow (q \leftrightarrow ((q \& r) \lor p)))\) \rightarrow \neg r\)
i. \(((r \& q) \rightarrow (p \lor \neg r)) \leftrightarrow (r \lor \neg r) \& (p \leftrightarrow q)\)
j. \(((\neg p \rightarrow q) \& (p \rightarrow \neg q)) \& (q \leftrightarrow p) \& (r \rightarrow q)\)

Truth tables

(2) * Construct the truth tables for \(\neg p \lor q\), \(-(p \lor q)\), and \(q \rightarrow \neg p\).

What do the truth tables show about these formulae?

(3) * Calculate the truth value of \((\neg p \lor q) \leftrightarrow (p \rightarrow q)\). What kind of proposition is this?

(4) * The sentences below illustrate a mismatch between natural language conditionals and material implication. What is the nature of the mismatch?

a. If Baltimore is in Singapore then Elvis is dead.
b. If Baltimore is in Singapore then Elvis is alive.

Connectives and pragmatics

The words *and*, *or*, and *if* are commonly augmented with pragmatic inference (see Section 1.4) in addition to their logical meaning (as defined in their truth tables).
Consider the group of sentences below. They illustrate a common pragmatic augmentation of and—what is it, and what kind of implicature do you think it is? Your proposal should explain the differences between the two sentences in each pair.

a. (i) He got on his horse and rode into the sunset.
   (ii) He rode into the sunset and got on his horse.

b. (i) Jake stepped on a ball bearing and nearly fell.
   (ii) Jake nearly fell and stepped on a ball bearing.

Construct the truth tables for the sentences below. The material implication analysis seems to give the wrong value to one of these sentences—which one, and why?

a. If Ireland is surrounded by sea then it is an island.
b. If Ireland is connected to Wales then it is an island.

We saw in Section 2.2.5 that the biconditional interpretation of if may be pragmatically derived from the material conditional interpretation. The word or also has two truth-functional interpretations: inclusive disjunction and exclusive disjunction. Logical disjunction is inclusive. Can you derive the exclusive disjunction interpretation of or pragmatically from inclusive disjunction? What sort of implicature would it be? (See Section 1.4 for implicature.)

The pair of sentences in (a) below are both true, and illustrate the equivalence between \( p \rightarrow q \) and \( \sim q \rightarrow \sim p \). The sentences in (b) look like an illustration of the same equivalence, but (ii) is odd. Can you explain why the (b) sentences are different from the (a) sentences?

a. (i) If Cain killed Abel then Abel is dead.
   (ii) If Abel isn’t dead then Cain didn’t kill him.

b. (i) If humans walk upright then they can use their hands to carry things.
   (ii) If humans can’t use their hands to carry things then they don’t walk upright.

Predicates and arguments

Give the logical forms for the following sentences.

a. John gave ten dollars to Mary.
b. Mary was given ten dollars by John.
c. Toby was under the table.
d. Clive showed Maddy the photos.
e. China is east of Europe.
f. Sheila is a surgeon.
g. Bill was painting the kitchen.
h. Bill was painting in the kitchen.
i. Mary finally bought the painting yesterday.
Predicates and arguments and co-ordination

(10) ★★★
Give logical representations for the sentences below. Compare the sentences to find clues on how to analyse BROTHER.

a. Jerry is Ben’s brother.
b. Paul is the brother of Sheila.
c. Jerry and Ben are brothers.

Now it should be easy to analyse (d):

d. Clive and Marcia embraced.

and say why (e) is peculiar.

e. The drunk and the lamppost embraced.

And finally, give the representation for (f):

f. Max, Clyde and Damien partnered Latoya, Gina and Britt respectively.

Predicates and arguments in complex propositions

(11) ★
Give the logical forms for the following sentences.
Example: Dorothy saw Bill or Alan.

\[ \text{SEE}(d, b) \lor \text{SEE}(d, a) \]

a. Either Sydney or Canberra is the capital of Australia.
b. Alice didn’t laugh and Bill didn’t either.
c. Frank is not both rich and generous.
d. Gina will marry Leo or Fred.
e. Alice didn’t laugh and nor did Bill.
f. If Adam trusts Eve he’s stupid.
g. Neither Bill nor Alice laughed.
h. Sue will be rich if Lenny dies.

(12) ★★★
The sentences below are ambiguous. Give two representations for each sentence to show the two meanings.

a. Audrey went to Motueka and visited Rangi or interviewed Cameron.
b. If David is Audrey’s brother then Fanny’s his aunt or Bob’s his uncle.
c. Claire will hire Burt and Ethel will resign if Lenny leaves Taiwan.

Complex predicates

Some verbal predicates are complex and consist of more than just the verb, such as put up with to mean ‘tolerate’. For these predicates we’ll use the whole verbal expression to symbolize the complex predicate, for example:

Judy won’t put up with Dean’s jazz records.

\[ \neg \text{PUT-UP-WITH}(j, \text{Dean’s jazz records}) \]
Give the logical representations for the sentences below (watch the prepositions).

a. Jean rang the hospital up.
b. Jules ran up the ramp.
c. Jules pushed the cart up the ramp.
d. Oliver looked after the departing train.
e. Oliver looked after the baby.
f. Giles wound the rope around the bollard.
g. Giles wound the clock up.

The sentences below are ambiguous. Give two representations for each sentence to show the two interpretations.

a. Giles ran down the new running track.
b. Imogen decided on the train.

Arguments and non-arguments

I said (see examples (43)–(44) in the chapter) that expressions of Time, Manner, and Place are generally non-arguments. There are some apparent exceptions to this.

Some of the expressions of Time, Manner and Place below are arguments of the verb. Which ones are they?

a. They dwelt in marble halls.
b. The theremin echoes marvellously in marble halls.
c. Jones behaved impeccably.
d. Harriet carelessly lost the car keys.
e. Simon carefully planned the weekend that night.
f. Simon carefully planned that night.
g. The meetings lasted all day.
h. The elephants were upset and nervous all day.

Consider the status of the bracketed sequences in the examples below. Are they arguments of the verb or not?

a. Jackson arrived [to clean the pool].
b. Jackson intended [to clean the pool].
c. Edith paid Lucas [for felling the tree].
d. Edith criticised Lucas [for felling the tree].

Consider the sentences below. One of each pair of sentences is generally agreed to be odd. First, decide which are the odd sentences. Can you form a generalization in terms of the distinction between arguments and non-arguments to explain why the odd sentences are odd?

(i) a. John sat on the bed.
b. John sat on the hillside.
(ii) a. The bed had been sat on.
   b. The hillside had been sat on.

(iii) a. All I did to the bed was sit on it.
     b. All I did to the hillside was sit on it.

FURTHER READING

Allwood, Andersson and Dahl’s (1977) Logic in Linguistics is an accessible introduction to first order logic and is particularly recommended (also for logical quantifiers addressed in Chapter 3).

For a recent comprehensive review of syntactic issues in argument structure, see Levin and Rappaport Hovav (2005). This is an advanced work which assumes some background in syntactic theory, but it is clearly written and not inaccessible.
3.1 The universal quantifier

The atomic propositions we have discussed so far have had individual arguments, referred to by names or noun phrases like the dog, with logical forms like these:

(1) a. John saw Mary SEE(j, m)  
   b. Fido was barking BARK(f)  
   c. The dog was barking BARK(the dog)

Propositions with quantified arguments rather than individual arguments (that is, quantified propositions) must be treated differently. Take the example below:

(2) God made everything.

The chief point here is that God and everything have very different kinds of meaning. While God is a name referring to an individual, everything doesn’t refer to a thing, but rather summarizes over individual references to each thing separately. Suppose it were possible to point to each thing in existence in turn and say ‘God made that’. According to (2) each utterance would be true, and (2) can be analysed as a sort of summary of all those propositions about different individuals.

Pronouns like that, this and it are referring expressions which can in principle refer to any individual depending on the circumstances in which they are used – they have variable reference, in contrast to names, which have constant reference. The logical terms used to translate names are individual constants. To analyse quantified propositions we need individual variables, comparable to pronouns. Individual variables are traditionally written as x, y and z, with u, v and w added if needed. Like this and that, individual variables can in principle refer to any individual at all, depending on the context.
With an individual variable the logical form for *God made that* can be written as (3):

\[(3) \text{MAKE}(g, x)\]

As it stands, (3) does not fix the reference for \(x\) and therefore doesn’t express a complete proposition and cannot be true or false. The universal quantifier, written as ‘\(\forall\)’, fixes how the variable is to be interpreted. The whole logical form for (2) is (4):

\[(4) \forall x(\text{MAKE}(g, x))\]

The quantifier is labelled with the variable which is its target, and the formula with which the quantifier combines is bracketed to fix the scope of the quantifier. Example (4) can be read as any of the paraphrases in (5):

\[(5) \text{For any value of } x, \text{ God made } x. \]
\[\text{For all values of } x, \text{ God made } x.\]
\[\text{Whatever } x \text{ may be, God made } x.\]

The universal quantifier sets and resets the value of \(x\) as every thing, taken individually. The quantifier binds the variable, which is accordingly a bound variable in the whole formula \(\forall x(\text{MAKE}(g, x))\). A variable which is not bound by a quantifier is a free variable. The \(x\) variable is free in the basic formula \(\text{MAKE}(g, x)\). A proposition form with a free variable such as \(\text{MAKE}(g, x)\) expresses an open proposition. An open proposition by itself is incomplete and cannot have a truth value. A formula with no free variables stands for a closed proposition, which is complete and has a truth value. Because there are no free variables in (4) it is a closed proposition.

Noun phrases expressing universal quantification are usually more complex than *everything*, as in (6):

\[(6) \text{a. Now is the time for *all good men* to come to the aid of the party. \quad b. *Every cloud* has a silver lining. \quad c. *Every dog* is barking.}\]

Take the significance of *dog* in (6c). Suppose *Every dog is barking* is true. Now you point to each thing in turn and say *that is barking*. This time the utterance will be false on many pointings, but for any pointing to a dog it will be true. In other words, if the thing pointed to is a dog then *that is barking* is true. So for *Every dog is barking*, the pointing exercise goes with the utterance of *If that is a dog then it is barking*, and the logical form for (6c) is (7), using the implication connective:

\[(7) \forall x(\text{DOG}(x) \to \text{BARK}(x))\]
\[\text{‘For every thing } x, \text{ if } x \text{ is a dog then } x \text{ is barking’}\]
The universal quantifier does not express existential commitment – that is, a sentence like *Every dog is barking* can be true on the logical analysis even when there are no dogs. On the logical analysis, if there are no dogs ‘Every dog is barking’ is true, because the antecedent DOG(x) will be false for any value of x. If there are no dogs, only lines 3 and 4 of the truth table for implication will come into play. On the logical analysis ‘Every dog is barking’ is equivalent to ‘There is no non-barking dog’.

\[
\begin{array}{ccc}
& \text{DOG}(x) & \text{BARK}(x) & (\text{DOG}(x) \rightarrow \text{BARK}(x)) \\
1 & T & T & T \\
2 & T & F & F \\
3 & F & T & T \\
4 & F & F & T \\
\end{array}
\]

A universally quantified noun phrase in object position or other sentence positions is analysed in the same way, for example:

(9) a. Bill hates all reporters.
    \[\forall x(\text{REPORTER}(x) \rightarrow \text{HATE}(b, x))\]
    ‘For all x, if x is a reporter then Bill hates x’

b. Clive gave a bone to every dog.
    \[\forall x(\text{DOG}(x) \rightarrow \text{GIVE}(c, \text{a bone}, x))\]
    ‘For all x, if x is a dog then Clive gave a bone to x’

c. The book was signed by every guest.
    \[\forall x(\text{GUEST}(x) \rightarrow \text{SIGN}(x, \text{the book}))\]
    ‘For all x, if x is a guest then x signed the book’

The expressions *a bone* and *the book* are not fully analysed here. The way we analyse *a bone* is addressed in the next section, and *the book* in Chapter 6.

### 3.2 The existential quantifier

The other standard logical quantifier, the existential quantifier, is written as ‘∃’ and used to translate noun phrases with *an* or *some* and for *there is* sentences. The sequence \[∃x\] is read as ‘there is an x’ or ‘there is at least one thing x’. Unlike the universal quantifier, the existential quantifier does explicitly express existential commitment. An existential sentence states the existence of at least one thing of the kind specified, for example:

(10) a. A dog barked.
    ‘There is at least one thing x such that x is a dog and x barked’
    \[∃x(\text{DOG}(x) \& \text{BARK}(x))\]

b. There is an antidote to Huntsman venom.
    \[∃x(\text{ANTIDOTE}(x, \text{h}))\]
c. Some birds were singing.
   \( \exists x (\text{BIRD}(x) \& \text{SING}(x)) \)

d. A black limousine awaited Marla.
   \( \exists x (\text{LIMOUSINE}(x) \& \text{BLACK}(x) \& \text{AWAIT}(x, m)) \)

e. Louise bought some trashy paperbacks.
   \( \exists x (\text{TRASHY}(x) \& \text{PAPERBACK}(x) \& \text{BUY}(l, x)) \)

As these examples show, the existential quantifier is neutral between singular and plural. (Note that \( \forall \) appears with \( \to \) in these examples but \( \exists \) appears with \&.)

The determiner *no* is analysed with the existential quantifier and negation, as in (11):

(11) a. There is no antidote to cyanide.
    \(-\exists x (\text{ANTIDOTE}(x, c))\)
    ‘It is not the case that there is an x such that x is an antidote to cyanide.’
    or ‘there is no x such that x is an antidote to cyanide.’

b. Clive ate nothing.
    \(-\exists x (\text{EAT}(c, x))\)
    ‘There is no x such that Clive ate x.’

In sentences like (11) the negation cancels the existential quantifier’s guarantee of the existence of a thing of the kind described. To affect the interpretation of the existential quantifier in this way, the negation must appear before the quantifier. Reversing the order of the existential quantifier and negation gives a different meaning, as in (12). This point is discussed further in Section 3.5.

(12) \( \exists x (\neg \text{EAT}(c, x)) \)
    ‘There is at least one thing x such that Clive didn’t eat x.’

### 3.3 Intersective and non-intersective adjectives

The examples in (10) included a point which needs further comment, concerning the analysis of so-called **attributive adjectives** (also called modifier adjectives). An attributive adjective appears before the noun in a noun phrase, like the underlined adjectives in *a black limousine* and *some trashy paperbacks* from (10d) = *A black limousine awaited Marla* and (10e) = *Louise bought some trashy paperbacks.* In contrast, adjectives which appear in the syntactic predicate of a sentence (not in a noun phrase), as in *The limousine was black*, are called **predicative adjectives**. The analyses for the attributive examples in (10) are repeated in (13):

(13) a. \( \exists x (\text{LIMOUSINE}(x) \& \text{BLACK}(x) \& \text{AWAIT}(x, m)) \)
    ‘For some x, x is a limousine and x is black and x awaited Marla.’

b. \( \exists x (\text{TRASHY}(x) \& \text{PAPERBACK}(x) \& \text{BUY}(l, x)) \)
    ‘For some x, x is trashy and x is a paperback and Louise bought x.’
The point to note here is that the separate conjuncts ‘x is a limousine’ and ‘x is black’ are individually entailed by (13a), and the separate conjuncts ‘x is trashy’ and ‘x is a paperback’ are individually entailed by (13b). In these examples the analysis works – a black limousine is something which is both black and a limousine, and similarly for a trashy paperback. Adjectives like these are called **intersective adjectives**, using a term taken from set theory, illustrated in (14):

\[(14) \quad \text{Set } A = \text{the set of limousines} \quad \text{and} \quad \text{Set } B = \text{the set of black things} \]

The intersection of A and B = the set of things which are both limousines and black

However, many adjectives are not intersective and cannot be analysed in this way, as illustrated in (15). If we analyse (15a) as in (15b), we get the unwanted entailment that the fake ruby is a ruby. In fact, the non-intersective adjective *fake* combines with *ruby* to denote something which is not a real ruby, but is a deliberate imitation of a ruby. For simplicity, we can represent this with a complex predicate FAKE RUBY, as in (15c), which does not entail that x is a ruby.

\[(15) \quad a. \quad \text{The statue held a fake ruby.} \\
   b. \#\exists x(\text{RUBY}(x) \& \text{FAKE}(x) \& \text{HOLD}(\text{the statue, } x)) \\
   c. \exists x(\text{FAKE RUBY}(x) \& \text{HOLD}(\text{the statue, } x)) \]

Other expressions like *fake ruby* are alleged assailant, *false hair*, *imitation leather*, *faux fur*, and so on.

### 3.4 The logical quantifiers are interdefinable

We saw above (see discussion of (7) and (8)) that *Every dog is barking* would be true if there were no dogs. Another way to think about the meaning of ∀ is that universality is the absence of exceptions. Then *All ravens are black* means something like ‘There are no exceptions to the blackness of ravens’, or ‘There are no non-black ravens’. Obviously if there are no ravens at all it follows that there are no non-black ravens. And we see that (16a) and (16b) are equivalent – they have the same truth conditions.

\[(16) \quad a. \forall x(\text{RAVEN}(x) \rightarrow \text{BLACK}(x)) \\
   \quad \text{‘All ravens are black’ or ‘There are no exceptions to the blackness of ravens’ or ‘There are no non-black ravens’.} \\
   b. \neg\exists x(\text{RAVEN}(x) \& \neg \text{BLACK}(x)) \\
   \quad \text{‘There are no non-black ravens.’} \]

Now consider a false universal statement such as *All geraniums are red*: the negation *It is not the case that all geraniums are red* is true. In fact there are many
non-red geraniums, but in order to establish the truth of *It is not the case that all geraniums are red* we only need at least one geranium of another colour – the actual number is immaterial. In other words, we only need to establish that non-red geraniumhood is instantiated. So (17a) and (17b) are equivalent. (Thinking of $\exists$ as expressing instantiation shows why this quantifier is indifferent to the difference between singular and plural, as we saw in Example (10) above.)

(17) a. It is not the case that all geraniums are red.
\[ \neg \forall x (\text{GERANIUM}(x) \rightarrow \text{RED}(x)) \]
b. $\exists x (\text{GERANIUM}(x) \& \neg \text{RED}(x))$
   ‘There is at least one non-red geranium’ or ‘Non-red geraniumhood is instantiated’.

The general pattern is that the logical quantifiers are **interdefinable with negation**.

(18) a. $\exists x (F(x))$ is equivalent to $\neg \forall x (\neg F(x))$
b. $\neg \exists x (F(x))$ is equivalent to $\forall x (\neg F(x))$
c. $\forall x (F(x) \rightarrow G(x))$ is equivalent to $\neg \exists x (F(x) \& \neg G(x))$
d. $\neg \forall x (F(x) \rightarrow G(x))$ is equivalent to $\exists x (F(x) \& \neg G(x))$

### 3.5 Scope and scopal ambiguity

#### 3.5.1 Scope and Tree Diagrams

Examples (11b) and (12) above, repeated in (19), show that the relative order of $\exists$ and $\neg$ is significant. In these examples, whichever expression comes first may affect the interpretation of the other, but not vice versa. The general phenomenon is **scope**: we say that the existential is in the scope of negation in (19a), but outside the scope of negation in (19b):

(19) a. $\neg \exists x (\text{EAT}(c, x))$
   ‘There is no thing such that Clive ate it.’
   ‘Clive ate nothing’
b. $\exists x (\neg (\text{EAT}(c, x))$
   ‘There is at least one thing Clive didn’t eat.’

Note that in these examples scope correlates with left-to-right order, but scope is not actually determined by order, as we shall see presently.

Not all types of expression take scope, and those that do are called **scopal expressions**. We will encounter quite a range of scopal expressions in the following chapters, and will review some general patterns here.

First, there are no scopal relations within a simple atomic proposition consisting of a predicate and its arguments, as in (20):

(20) Jones admires Knievel. $\text{ADMIRE}(j,k)$
We add negation or quantification to a proposition as a whole. The proposition constitutes the scope of the quantifier or negation, or in other words, the quantifier or negation takes scope over the proposition.

(21) Jones admires all bikers.

\[ \forall x \text{ BIKER}(x) \rightarrow \text{ADMIRE}(j, x) \]

Scopal expressions preceding a proposition are added one at a time. The negation of (21) is (22) ‘It is not the case that Jones admires all bikers’ or ‘Jones doesn’t admire all bikers’:

(22)

\[ \sim \forall x \text{ BIKER}(x) \rightarrow \text{ADMIRE}(j, x) \]

The kind of diagram in (21) and (22), called a tree diagram, is useful to clarify exactly what combines with what in a formula, and to show scope. A tree diagram is mapped using relational terms as illustrated in (23):

(23)

\[ \text{A} \]

\[ \text{B} \]

\[ \text{C} \]

\[ \text{D} \]

\[ \text{E} \]

A, B, C, D, and E are nodes.
A is the mother node of B and C.
C is the mother node of D and E.
B and C are sisters; D and E are sisters.

Scope can be defined as follows: A node has scope over its sister(s) and all descendants of its sister(s). (Readers with a background in syntax may recognize that scope is based on the formal relation also termed c-command.)

Adding node names to the diagram in (22) gives (24). According to the definition, negation in node \( b \) in (24) has scope over its sister node \( c \) and all that is below \( c \) — that is, \( d \) and \( e \). The universal quantifier in node \( d \) has scope over its sister node \( e \) which is \( \text{BIKER}(x) \rightarrow \text{ADMIRE}(j, x) \).
Tree diagrams may also be useful to clarify the structure of complex propositions as in (25). The tree diagram in (25c) shows the structure in which disjunction in node $c$ has scope over the two conjunctions in nodes $f$ and $i$, but not vice versa.

(25)  

a. Either Gina died and Jones inherited the house, or Gina sold the house and Jones rented it.

b. $(\text{DIE}(g) \& \text{INHERIT}(j, \text{the house})) \lor (\text{SELL}(g, \text{the house}) \& \text{RENT}(j, \text{the house}))$

c. 

Tree diagrams also show clearly how left-to-right order need not correlate with relative scope. In (26) the universal and existential quantifiers each have separate scopes, with neither quantifier having scope over the other. The two conjuncts of (26) can be in either order (both in the sentence and in the formula) without affecting the scopes of the quantifiers.

(26)  

a. Jones ate everything on his plate and Harris ate a bun.

b. Harris ate a bun and Jones ate everything on his plate.

c. $\forall x (\text{ON}(x, \text{Jones’ plate}) \rightarrow \text{EAT}(j, x)) \& \exists y (\text{BUN}(y) \& \text{EAT}(h, y))$

d. $\exists y (\text{BUN}(y) \& \text{EAT}(h, y)) \& \forall x (\text{ON}(x, \text{Jones’ plate}) \rightarrow \text{EAT}(j, x))$
3.5.2 Scopal ambiguity

So far, the examples with more than one scopal expression (e.g., Clive didn’t eat anything) have had clear meanings which indicate how to assign scope to the scopal expressions. This isn’t always the case: a sentence with two scopal expressions can be ambiguous, with both scopes representing possible interpretations of the sentence (though in speech, different intonations may emphasize one meaning or the other). This is called scopal ambiguity, illustrated in (27), where the sentence in (27a) can be interpreted as (27b) or (27c):

(27) a. Every quiz was won by some Belgian.
    b. ‘There was a certain Belgian who won all the quizzes.’
    c. ‘For each quiz, it was won by a Belgian’ or ‘All the quiz-winners were Belgian.’
Consider (27b) first: There is a particular Belgian, about whom we go on to say that he or she won every quiz. The tree diagram for this is in (28):

\[
(28) \quad \exists x \text{ takes scope over } \forall y
\]

\[
\begin{array}{c}
(28) \\
\exists x \\
\text{BELGIAN}(x) \\
\& \\
\forall y \\
\text{QUIZ}(y) \rightarrow \text{WIN}(x, y)
\end{array}
\]

The interpretation in (27c) is diagrammed in (29).

\[
(29) \quad \forall x \text{ takes scope over } \exists y
\]

\[
\begin{array}{c}
(29) \\
\forall x \\
\exists y \\
\text{QUIZ}(x) \rightarrow \\
\text{BELGIAN}(y) \& \text{WIN}(y, x)
\end{array}
\]

In (28)–(29) the lower quantifier is placed immediately before its own smallest scope. This corresponds to what seems to be the most orderly unpacking of the information as illustrated in (30)–(31):

\[
(30) \quad \begin{array}{l}
\exists x (\text{BELGIAN}(x) \& \forall y (\text{QUIZ}(y) \rightarrow \text{WIN}(x, y))) \\
\end{array}
\]

\[
\begin{array}{l}
1 \quad 2 \\
3 \quad 4
\end{array}
\]

\[
\begin{array}{l}
\exists x \quad \{\text{BELGIAN}(x) \& \forall y (\text{QUIZ}(y) \rightarrow \text{WIN}(x, y))\}
\end{array}
\]

b. 1 ‘There is someone x
2 who is a Belgian and
3 for every y
4 if y is a quiz then x won y.’
(31)  a. \( \forall x (\text{QUIZ}(x) \rightarrow \exists y (\text{BELGIAN}(y) \& \text{WIN}(y, x))) \)

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
</table>

b.  1 For everything \( x \)
    2 if \( x \) is a quiz then
    3 there is someone \( y \)
    4 who is a Belgian and won \( x \)

Equivalent formulae can be written with the lower quantifier shown higher in
the structure, as in (32), although these tend to be less easy to read.

(32)  a. \( \exists x \forall y (\text{BELGIAN}(x) \& (\text{QUIZ}(y) \rightarrow \text{WIN}(x, y))) \)

    'For some \( x \) and for all \( y \), \( x \) is a Belgian and if \( y \) is a quiz then \( x \)
    won \( y \).'</n
b. \( \forall x \exists y (\text{QUIZ}(x) \rightarrow (\text{BELGIAN}(y) \& \text{WIN}(y, x))) \)

    'For all \( x \) there is a \( y \) such that if \( x \) is a quiz then \( y \) is a Belgian and
    \( y \) won \( x \).'

---

**EXERCISES**

(1) *
Using \( \forall \) and \( \exists \) where appropriate, write logical forms for the sentences below.

a. Every possum was brown.
   b. John ate a sandwich.
   c. A young woman was speaking.
   d. Kerry filled all the gaps.
   e. Every guest thanked Jones.

(2) **
Using \( \forall \) and \( \exists \) where appropriate, write logical forms for the sentences below.

a. There was a black hat on the bed.
   b. All roads lead to Rome.
   c. Utopia welcomes all travellers from Spain.
   d. Clive got murdered.
   e. Jones read every book in the library.
   f. Ada saw something nasty in the woodshed.
   g. Every cloud has a silver lining. (Give the formula for the normal reading of the
      proverb.)

(3) ***
Using \( \forall \) and \( \exists \) where appropriate, write logical forms for the sentences below.

a. Jones cleaned and framed every painting that Brice found in the cellar.
   b. Chairman Miaou is heavier and meaner than any spaniel.
c. Grammar A generates all and only well-formed formulae. (Treat Grammar A as a name.)
d. Clive gave every child either a biscuit or a Batman comic.
e. Zoe read all the death notices but nothing else.
f. There’s no business like show business. (Treat show business as a name.)
g. If everyone leaves the room then the room will be empty.
h. If someone leaves the cab then Jones will put the luggage in the cab. (It doesn’t matter who leaves to make more space.)

(4) ***
Write the formulae for the sentences below (see Section 3.3).

a. The small goat was bigger than the big spider.
b. There were counterfeit doubloons in the drawer.
c. Jack’s cold tea was warmer than Harry’s warm beer.
   Hint: Use a predicate POSS to represent possession, as in:
   \[ \exists x (\text{BOAT}(x) \land \text{POSS}(g, x) \land \text{PAINT}(j, x)) \]

Negation

(5) *
Using \( \forall \) and \( \exists \), write logical forms for the sentences below.

a. Not everyone likes Bob.
b. Bob doesn’t like anyone.

(6) ***
The sentences below strike many people as ambiguous, depending on the intonation. Can you identify and represent particular readings to go with different ways of stressing the sentences?

a. Bob doesn’t like everyone.
b. Everyone doesn’t like Bob.

Scopal ambiguity

(7) **
The sentences below are scopally ambiguous. Give a clear unambiguous paraphrase for each reading and match it with its formula and tree diagram.

a. Every prize was won by some high school kid.
b. Someone had scribbled on every wall in the kitchen.
c. Every cheerleader had shared a milkshake with Jones. (Treat share as a 3-place predicate ‘x shares y with z’.)

FURTHER READING

As for predicates and arguments in the previous chapter, Allwood, Andersson, and Dahl (1977) is particularly recommended.
I said in Chapter 1 that meaning is compositional, in that the meaning of a sentence is determined by the composition of the sentence from its parts: the meanings of the words in it and the way they are ordered into phrases. Compositional semantic theories assume that the syntax and semantics work in parallel. For each phrase structure rule that combines two expressions into a larger phrase, there is a corresponding semantic rule which combines the meanings of the parts into the meaning of the newly formed expression.

So far, we haven’t addressed how the elements of meaning are combined into representations of propositions, but have mainly practised translating English into logical notation. Now that we have covered some of the basics, this chapter will outline how formal composition works – that is, how we assign meanings to words and their combinations to build representations of propositions.

The next two sections will introduce two essential tools: first, a way of classifying expressions into types, based on their kind of denotation and ways of combining with other expressions; and second, the lambda calculus, which provides a unified analysis for how bits of meaning combine.

### 4.1 Types

Linguistic expressions are classified into their semantic types according to the kind of denotation they have. The two most basic denotation types are type \( e \), the type of entities, and type \( t \), the type of truth values. The meaning of a name (that is, its referent) is of type \( e \). The denotation or extensional meaning of a sentence is its truth value, so the meaning of a sentence is of type \( t \). All the other types are constructed from the two basic types, and are functions.

### 4.2 Functions

Recall that in Chapter 2, predicates were identified as ‘the remainder’ of a statement when the entities are removed, as in (1) below:

(1) Moscow is east of Paris.
    Remove the entities ⇒ _ is east of _
Remove the small syntactic words and keep the main expression of the relation: the predicate is EAST.

This tactic rests on the intuitive recognition of entities, and then the predicate is what is left over. The converse intuition is that words like *east* are semantically incomplete without arguments – the meaning of a predicate is such that it specifies the ‘need’ to take arguments. The philosopher Gottlob Frege coined the term *unsaturated* to describe this quality. Semantically complete expressions like names and statements, on the other hand, are *saturated*. Frege wrote:

Statements in general...can be imagined to be split up into two parts; one complete in itself, and the other in need of supplementation, or ‘unsaturated’. Thus, e.g., we split up the sentence ‘Caesar conquered Gaul’ into ‘Caesar’ and ‘conquered Gaul’. The second part is ‘unsaturated’ – it contains an empty place; only when this place is filled up with a proper name, or with an expression that replaces a proper name, does a complete sense appear. Here too I give the name ‘function’ to what this ‘unsaturated’ part stands for. In this case the argument is ‘Caesar’.

(1891/1980: 31)

Another way of looking at functions (and predicates) is to say that a function binds arguments together into a statement. From this insight, Frege proposed that all semantic composition is functional application. Functional application is just the combination of a function with an argument. The function-argument bond is the ‘glue’ that holds complex meanings together. Here semantic composition proceeds by combining two expressions \( A \) and \( B \) where \( A \) is a function and \( B \) is its argument. Another important point is that combination is taken to be binary, in that only two expressions are combined in each operation. In syntactic terms, this means that every node in a tree diagram has no more than two daughter nodes.

\[
\begin{align*}
(2) & \quad \text{this} & A \\
 & \quad \downarrow & & \quad \downarrow \\
 & \quad B & C & B & C & D \\
& \quad \text{but not this:} & A \\
\end{align*}
\]

### 4.3 Types of function

The different kinds of semantic function are defined in terms of their combinatorial properties. The general pattern for naming functions is shown in (3):

\[
(3) \quad \text{A function } F \text{ combines with a type } B \text{ to form a type } C. \quad F \text{ is type } <B, C>
\]
Following this general pattern, functions are defined to give interpretations for predicates. Simple 1-place predicates of any lexical category, such as the common noun dog, adjective red, and intransitive verb grin or walk, are all functions that combine with an entity to produce a statement. Recall that the denotation of a statement is of type t. So a 1-place predicate takes an e as argument and the result is a t. The type of 1-place predicates is \( <e, t> \), as in (4):

\[
(4) \quad S \quad t \\
NP \quad VP \quad e \quad <e, t>
\]

A 2-place predicate is an expression which takes an entity as argument to form a 1-place predicate. Following the general pattern in (3), a 2-place predicate is of type \( <e, <e, t>> \): the function takes an e to form an \( <e, t> \). Common 2-place predicates are prepositions (beside, under, in, on), transitive verbs (like, pat, see), some common nouns (friend, brother, colleague), and some adjectives (higher, hostile).

\[
(5) \quad S \quad t \\
NP \quad VP \quad e \quad <e, t>
\]

Proceeding in the same way for 3-place predicates, we see that the tree diagram must be different from what is commonly used in introductory syntax.
classes. In introductory syntax a sentence like *Fred sent the parcel to Louie* is often diagrammed as in (6), with the verb phrase (VP) node having three daughters, not two.

(6) 
```
S  Fred sent the parcel to Louie.
   /   \
NP   VP
   /   /  \ 
N   V   NP  PP
  / \   / \
Fred sent Det N P NP
    /   /  \ 
   the parcel to N
```

This analysis is inconsistent with the assumption that functional application is binary, and therefore every node has at most two daughter nodes. But in more advanced syntactic models binary branching is also assumed for syntactic combination, and consequently, the verb phrase is reanalysed with binary branching in a way that is consistent with what the semantic theory requires. A simplified deep structure for *Fred sent the parcel to Louie* is shown in (7). This tree shows a non-final word order *Fred the parcel sent to Louie*. The final word order *Fred sent the parcel to Louie* is the result of syntactic raising of the verb to a position higher in the tree. For our purposes, the simplified tree in (7) shows the appropriate structure for the semantics.

(7) 
```
S
   /   \
NP   VP
   /   /  \
N   NP   VP
  /   /   /  \
Fred Det N   V  P NP
    / \    / \
   the parcel sent P NP
     /   /  \ 
    to N
```

Louie
As the tree in (7) shows, a 3-place predicate is a function that takes an e argument to form a 2-place predicate: here *sent* takes (to) *Louie* to form a 2-place predicate *sent to Louie*, which takes the parcel to form a 1-place predicate *sent the parcel to Louie*. Leaving out all non-essential detail, the tree can be simplified to (8):

```
(8)                               t
    e                                <e, t>
    <e, t>                           Fred
    e                                <e, <e, t>>
    <e, <e, t>>                      the parcel
    e                                <e, <e, <e, t>>>            e
    sent         (to) Louie
```

We can define a simple type for the determiner *the* in a singular noun phrase such as *the dog*. The main quantificational determiners like *every*, *most*, *few*, etc. do not form a noun phrase that refers to any entity in particular – consider *every Pacific island*, *most dentists*, *few mice*. In contrast, *the* in many (but not all) of its uses does form a referring noun phrase, as illustrated in (9) below. Here the determiner combines with a noun (of type <e, t>) to form an expression that is presumably of type e because it refers to an entity. So here the type for *the* can be analysed as <<e, t>, e>, and for convenience we can call this use of the ‘e-forming the’.

```
(9) The dog was asleep by the fire.
    NP     e
    D  N        <<e, t>, e>         <e, t>
    the            dog  the           dog
```

The last kind of function to be considered here is the type of modifiers. So far, all the types we have seen have taken an argument which is of a different type from the newly formed expression. The main characteristic of modifiers is that functional application does not change the type of the argument, so all modifiers are of the general type <A, A>. (This treatment is simplified, but will serve the present purpose.)

```
(10) Bacchus is happy.  happy is of type <e, t>
    Bacchus is very happy.  very happy is of type <e, t>
    very is of type <<e, t>, <e, t>>
```
FORMAL COMPOSITION

(11) Mercury runs. \(\text{runs is of type } <e, t>\)
Mercury runs fast. \(\text{runs fast is of type } <e, t>\)
\(\text{fast is of type } <e, t>, <e, t>\)

4.4 Lambda abstraction

We have been using a convention of representing predicates in capital letters; for example, the predicate in *Harriet gave the parcel to Tom* is symbolized as GIVE. This isn’t sufficient to identify what type the predicate belongs to, as it doesn’t show the argument structure of the predicate; that is, how many arguments the predicate requires. The argument structure determines the function type. We could show the argument structure by adding variables, as in (12):

(12) GIVE(x, y, z)

This is an improvement, but still not ideal. The form in (12) corresponds to an open proposition, which is not the same thing as a predicate. The variables in (12) could be treated like referring pronouns and assigned a reference from context, as in an utterance of *She gave it to him*. With the contextual reference added, *She gave it to him* would express a closed proposition with a truth value; that is, an expression of type \(t\). We want to analyse words like *give* to show clearly that a function and not a proposition is represented. For this we use the \(\lambda\)-operator (\(\lambda\) is the Greek letter *lambda*) which turns a proposition into a function. The way \(\lambda\) works is most easily explained by examples.

Take a proposition and pick one argument position within it.

(13) Harriet gave the parcel to Donald. GIVE(h, the parcel, d)

The selected argument position is filled by a variable, and the \(\lambda\)-operator binds the variable. For ease of reading, the scope of the \(\lambda\)-operator is conventionally enclosed in square brackets. The new formula as in (14) expresses the predicate ‘Having the property of being the entity that Harriet gave to Donald’. This way of forming a function from a proposition is called *lambda abstraction* (or \(\lambda\)-abstraction).

(14) \(\lambda x[\text{Harriet gave } x \text{ to Donald}]\) \(\lambda x[\text{GIVE}(h, x, d)]\)

The other argument positions can also be \(\lambda\)-abstracted to form different predicates:

(15) \(\lambda x[\text{GIVE}(x, \text{the parcel}, d)]\)
‘having the property of being the entity that gave the parcel to Donald’

(16) \(\lambda x[\text{GIVE}(h, \text{the parcel}, x)]\)
‘having the property of being the entity that Harriet gave the parcel to’
In all the Examples (14)–(16) the lambda function is a 1-place predicate because only one argument position is affected by lambda abstraction. The notation for combining a function with an argument is to place the bracketed argument after the function:

(17) \( \lambda x[\text{GIVE}(h, x, d)] \) (the parcel)
(18) \( \lambda x[\text{GIVE}(x, \text{the parcel}, d)] \) (h)
(19) \( \lambda x[\text{GIVE}(h, \text{the parcel}, x)] \) (d)

The general operation of lambda reduction (also called lambda conversion) simplifies the formula by placing the argument in the \( \lambda \)-bound position and deleting the \( \lambda \)-operator:

(20) \( \lambda x[\text{GIVE}(h, x, d)] \) (the parcel) \Rightarrow \text{GIVE}(h, \text{the parcel}, d)
(21) \( \lambda x[\text{GIVE}(x, \text{the parcel}, d)] \) (h) \Rightarrow \text{GIVE}(h, \text{the parcel}, d)
(22) \( \lambda x[\text{GIVE}(h, \text{the parcel}, x)] \) (d) \Rightarrow \text{GIVE}(h, \text{the parcel}, d)

Note that lambda reduction simplifies the formula but doesn’t change the interpretation, so the reduced and non-reduced versions are equivalent, for example:

(23) \( \lambda x[\text{GIVE}(x, \text{the parcel}, d)] \) (h) is equivalent to \( \text{GIVE}(h, \text{the parcel}, d) \)

Using lambda abstraction we can now define the predicates in the lexicon according to their types. Begin with the basic 1-place predicates. Form an open proposition with the predicate and add \( \lambda \) abstraction:

(24) \( \text{DOG} \Rightarrow \text{DOG}(x) \Rightarrow \lambda x[\text{DOG}(x)] \)

Further definitions for 1-place predicates – functions of type \( <e, t> \) – are illustrated in (25). Note that a linguistic expression contained in double upright brackets \://\: symbolizes the denotation of the expression – for example, \( \langle \text{grin} \rangle \) is the symbol for ‘the denotation of the word grin.’

(25)  
\[ \langle \text{grin} \rangle = \lambda x[\text{GRIN}(x)] \]
\[ \langle \text{dog} \rangle = \lambda x[\text{DOG}(x)] \]
\[ \langle \text{red} \rangle = \lambda x[\text{RED}(x)] \]

Now consider 2-place predicates which are of type \( <e, <e, t>> \). There are two argument positions to be targeted by \( \lambda \)-abstraction, and the arguments are
added one at a time. Take *Midge likes icecream*:

(26)

\[
S \\
\downarrow \ \\
NP \quad VP \\
\downarrow \ \\
Midge \quad V \quad NP \\
\downarrow \ \\
likes \quad icecream
\]

The function corresponding to *likes* takes the direct object argument *icecream* first, so the outermost lambda operator binds the object argument position. The subject argument is combined last, so the inner lambda operator binds the subject argument position.

(27) combined first: combination of verb + object

\[
\| \text{likes} \| = \lambda y \ [\lambda x \ [\text{LIKE}(x, y)]]
\]

combined second: combination of subject + verb phrase

To represent the whole proposition prior to \(\lambda\)-reduction, both arguments are listed in brackets after the function. The left-to-right order of the arguments corresponds to the order in which the arguments are composed.

(28) Midge likes icecream. \(\lambda y \ [\lambda x \ [\text{LIKE}(x, y)]\] (i) (m)

The corresponding (simplified) syntactic and semantic structures are shown in (29):

(29) 

\[
S \\
ge \\
\uparrow \ \\
\text{t} \quad \text{LIKE}(m, i) \\
\downarrow \ \\
e \quad <e, t> \\
\downarrow \ \\
\lambda x[\text{LIKE}(x, i)] \\
\downarrow \ \\
<e, e, t> \\
\downarrow \ \\
\lambda y[\lambda x[\text{LIKE}(x, y)]] \\
\downarrow \ \\
n \quad v \quad n \\
\downarrow \ \\
\text{Midge} \quad \text{likes} \\
\downarrow \ \\
\text{icecream}
\]
Continuing in the same way, a 3-place predicate of type $<$e, <e, <e, t$>>$ is analysed as illustrated in (30), using the syntactic structure that was introduced in Example (7) above.

(30) Barry introduced Kerry to Murray.

In syntax, a close parallel to lambda abstraction is the formation of a restrictive relative clause, which also turns a propositional form into a predicate. Taking the sentence Harriet gave the parcel to Donald from Examples (13)–(22) above, each of the 1-place predicates formed by $\lambda$-abstraction has a corresponding relative clause. A relative clause like those below is a 1-place predicate of type $<$e, t$>$.

(31) Relativize/abstract the position of Harriet: (the person) who gave the parcel to Donald:
$$\text{who gave the parcel to Donald} = \lambda x[\text{GIVE}(x, \text{the parcel, d})]$$

(32) Relativize/abstract the position of the parcel: (the thing) that Harriet gave to Donald:
$$\text{that Harriet gave to Donald} = \lambda x[\text{GIVE}(h, x, d)]$$

(33) Relativize/abstract the position of Donald: (the person) to whom Harriet gave the parcel:
$$\text{to whom Harriet gave the parcel} = \lambda x[\text{GIVE}(h, \text{the parcel, x})]$$

Lambda abstraction also allows us to resolve a potential problem for strict compositionality that we saw in Chapter 2. Natural language syntax allows
conjunction reduction and disjunction reduction, but standard logical notation does not.

\[(34)\] 
\begin{align*}
\text{Verb phrase} \\
\text{a.} \quad \text{Fred danced and sang.} \\
\text{b.} \quad \text{DANCE(f) \& SING(f)} \\
\text{c.} \quad \ast \text{DANCE \& SING(f)}
\end{align*}

The problem with (34c) is that the logical connectives can only combine propositional forms, and cannot combine bare predicate symbols, so it seems that we can't give a translation for the verb phrase \textit{danced and sang} using conjunction. However, \(\lambda\) abstraction solves the problem, as illustrated in (35), where the conjoined formulae DANCE(x) and SING(x) have the required propositional form.

\[(35)\] 
\begin{align*}
\text{a.} \quad \| \text{dance and sing} \| = \lambda x [\text{DANCE}(x) \& \text{SING}(x)] \\
\text{b.} \quad \text{Fred danced and sang:} \\
\lambda x [\text{DANCE}(x) \& \text{SING}(x)] (f) = [\text{DANCE}(f) \& \text{SING}(f)]
\end{align*}

### 4.5 Some general rules for semantic composition

The composition of the interpretation of a sentence proceeds step by step as the components are combined in syntax. To trace the parallel composition of the meaning step by step, we need general rules for composing the interpretation of different kinds of node in the tree.

**Terminal nodes:** A terminal node is at the bottom of a branch of the tree, corresponding to a word in syntax.

**Terminal Node Rule:** The interpretation of a terminal node is taken from the lexicon.

\[(36)\]  
\begin{align*}
\| \text{dog} \| = \lambda x [\text{DOG}(x)] \\
\text{N} = \lambda x [\text{DOG}(x)]
\end{align*}

**Non-branching nodes:** A non-branching node has a single daughter node.

**Non-branching Node Rule:** The denotation of a non-branching node is the same as the denotation of its single daughter.

\[(37)\]  
\begin{align*}
\| \text{VP} \| = \lambda x [\text{WALK}(x)] \\
\| \text{NP} \| = \lambda x [\text{RUM BABA}(x)] \\
\| \text{V} \| = \lambda x [\text{WALK}(x)] \\
\| \text{N} \| = \lambda x [\text{RUM BABA}(x)]
\end{align*}
**Branching nodes**: A branching node has exactly two daughter nodes. The daughter nodes can be (i) a function and its argument or (ii) two functions, one modifying the other.

**Branching node: function + argument**: There is no separate rule for the combination of a function with its argument, which is interpreted as **Functional Application** (followed by \(\lambda\)-reduction).

\[
(38) \quad \text{S} \quad \text{ROCK(a)}
\]

Functional Application: \(\lambda x[\text{ROCK}(x)]\) (a)

Lambda Reduction

**Branching node: two functions, one modifying the other**: Modifiers can be complex and tricky to analyse. Here we will stick to the so-called **intersective modifiers** which work like the examples introduced in Chapter 3, omitting the modifiers like *very* in (10) above. For example, in Chapter 3 we would analyse *A blue umbrella was on the table* as \(\exists x(\text{BLUE}(x) \& \text{UMBRELLA}(x) \& \text{ON}(x, \text{the table}))\). The analysis of *a blue umbrella* here treats *blue* as an intersective modifier, where the modifier *blue* and the modified predicate *umbrella* are conjoined. This analysis entails that the two statements *x was blue* and *x was an umbrella* must both be true independently. There are numerous non-**intersective modifiers**, such as *fake*: a fake diamond is not a diamond, so *There was a fake diamond* cannot be analysed as \(\exists x(\text{FAKE}(x) \& \text{DIAMOND}(x))\), because this would falsely entail that *x* was a diamond.

Noting that not all modifiers are intersective, we can define intersective modification as conjunction. The modifiers we have seen so far are of type \(<e, t>\), and the rule for these is in (39). (This is simplified – the rule is revised as functional application at the end of the next section.)

\[
(39) \quad \text{Intersective Modifier Rule: } I A_{<e, t>} + B_{<e, t>} I = \lambda x[A(x) \& B(x)]
\]

\begin{align*}
a. \quad I \text{blue umbrella} I & = \lambda x[\text{BLUE}(x) \& \text{UMBRELLA}(x)] \\
b. \quad I \text{man that Cain killed} I & = \lambda x[\text{MAN}(x) \& \text{KILL}(c, x)] \\
I \text{man} I & = \lambda x[\text{MAN}(x)] \\
I \text{that Cain killed} I & = \lambda x[\text{KILL}(c, x)]
\end{align*}

We can use a simplified rule for analysing restrictive relative clauses based on the examples in (31)–(33) above.
FORMAL COMPOSITION

(40) **Simple Restrictive Relative Clause Rule**: $\lambda$-abstract the relativized argument.

- (the person) \textit{who gave the parcel to Donald} = $\lambda x [\text{GIVE}(x, \text{the parcel}, d)]$
- (the thing) \textit{that Harriet gave to Donald} = $\lambda x [\text{GIVE}(h, x, d)]$
- (the person) \textit{to whom Harriet gave the parcel} = $\lambda x [\text{GIVE}(h, \text{the parcel}, x)]$

Finally, we can adopt a simple rule for e-forming \textit{the} of type $<e, t>$, $e$ from Example (9) above, \textit{The dog was asleep by the fire}. A noun phrase like \textit{the dog} in this context refers to the entity such that it is the only dog – that is, there is only one dog and \textit{the dog} refers to it. The requirement of uniqueness is generally particular to the specific context, so that \textit{the dog} is understood as ‘the single dog that the family owns’ ‘the single dog that is in the room at present’, ‘the single dog that I’m currently talking about’, and so on. If we consider the actual content of the contextual information to be pragmatic, then we can define the semantics of singular \textit{the} in terms of the requirement ‘the only one’. (The semantics of \textit{the} is discussed in more detail in Chapter 6.) The ‘only one’ requirement is expressed by the \textbf{iota operator} $\iota$ which combines with a predicate to form an e-type expression, as illustrated in (41) and defined in (42):

(41) $tx(\text{DOG}(x)) = a$ iff $\exists y (\text{DOG}(y) \land \forall z (\text{DOG}(z) \leftrightarrow z = y) \land y = a)$

- ‘the dog is the entity $a$ if and only if ...’
- $\exists x (\text{DOG}(x) \land \forall y (\text{DOG}(y) \leftrightarrow y = x)$
  - ‘there is a dog $x$, and any entity $y$ is a dog if and only if $y$ is the same entity as $x$,’ (i.e. ‘$x$ is the only dog’), ...
- $\land x = a$
  - ‘and $x$ is the same entity as $a$

(42) **General definition for the iota operator**:  

\[ tx(P(x)) = a \text{ iff } \exists x (P(x) \land \forall y (P(y) \leftrightarrow y = x) \land x = a) \]

Using the iota operator, the simple rule for e-forming \textit{the} is (43):

(43) **Simple Rule for e-forming the**:  

\[ \| \textit{the P} \| = tx(P(x)) \quad tx(P(x)) \text{ is of type } e \]

And finally, given that an e-type expression denotes an individual, we can further simplify the representation of an e-type NP by assigning a logical constant to the referent:

(44) **Assigning a constant to an e-type NP**:  

\[ tx(P(x)) = a \]
Now we can put the definitions and composition rules together to build a truth condition step by step, for example:

(45)  *Barry introduced Kerry to Murray*  
Treat *to* as a purely syntactic expression – it can be omitted.  
From the lexicon:  
\[ \text{\(\llbracket \text{Barry}\rrbracket = b\)} \]  
\[ \text{\(\llbracket \text{Kerry}\rrbracket = k\)} \]  
\[ \text{\(\llbracket \text{Murray}\rrbracket = m\)} \]  
\[ \text{\(\llbracket \text{introduce}\rrbracket = \lambda z[\lambda y[\lambda x[\text{INTRODUCE}(x, y, z)]]]\)} \]  

Terminal Node Rule:  
\[ \text{\(\llbracket N_1\rrbracket = \llbracket \text{Barry}\rrbracket = b\)} \]  
\[ \text{\(\llbracket N_2\rrbracket = \llbracket \text{Kerry}\rrbracket = k\)} \]  
\[ \text{\(\llbracket N_3\rrbracket = \llbracket \text{Murray}\rrbracket = m\)} \]  
\[ \text{\(\llbracket V\rrbracket = \llbracket \text{introduce}\rrbracket = \lambda z[\lambda y[\lambda x[\text{INTRODUCE}(x, y, z)]]]\)} \]  

Non-Branching Node Rule:  
\[ \text{\(\llbracket NP_1\rrbracket = \llbracket N_1\rrbracket = \llbracket \text{Barry}\rrbracket = b\)} \]  
\[ \text{\(\llbracket NP_2\rrbracket = \llbracket N_2\rrbracket = \llbracket \text{Kerry}\rrbracket = k\)} \]  
\[ \text{\(\llbracket NP_3\rrbracket = \llbracket N_3\rrbracket = \llbracket \text{Murray}\rrbracket = m\)} \]  
\[ \text{\(\llbracket S\rrbracket = \text{INTRODUCE}(b, k, m)\)} \]  

Now we’ll take an example with a more complicated NP. In the example below I have repeated the content of some of the rules for convenience, but this isn’t necessary.
The car that Jones liked was red

From the lexicon:

\[
\text{car} = \lambda x [\text{CAR}(x)] \\
\text{like} = \lambda y [\text{LIKE}(x, y)] \\
\text{red} = \lambda x [\text{RED}(x)]
\]

Terminal Node Rule:

\[
\text{N} = \lambda x [\text{CAR}(x)] \\
\text{A} = \lambda x [\text{RED}(x)]
\]

Non-Branching Node Rule:

\[
\text{AP} = \lambda x [\text{RED}(x)]
\]

Simplified Restrictive Relative Clause Rule: \(\lambda\)-abstract the relativized argument

\[
\text{S} = \lambda x [\text{LIKE}(j, x)]
\]

Intersective Modifier Rule:

\[
\text{N} = \lambda x [\text{CAR}(x)] & \text{LIKE}(j, x)] = \lambda x [\text{CAR}(x) & \text{LIKE}(j, x)]
\]

Simple Rule for e-forming the:

\[
\text{NP} = \lambda x [\text{CAR}(x) & \text{LIKE}(j, x)]
\]

Assigning a constant to an e-type NP:

\[
\text{NP} = \lambda x [\text{CAR}(x) & \text{LIKE}(j, x)] = \lambda x [\text{RED}(x)]
\]

This completes the basic discussion of compositionality. At this point you can tackle Exercises (1)–(6) and (9).

### 4.6 Predicate variables

In Section 4.3 above we identified a range of types in terms of e and t, but not all of these have yet been analysed as \(\lambda\)-functions. To form \(\lambda\)-functions we
need the \(\lambda\)-operator and variables for the kind of expression that the \(\lambda\)-operator binds. The verbs we have analysed so far all take arguments of type \(e\), represented by individual variables \(x, y, z\), and so on. In this section we add predicate variables to construct \(\lambda\)-functions for the remaining types – \(e\)-forming the, intersective modifiers, and the determiner \(a/an\) in a predicate noun phrase.

We begin with a more explicit analysis for \(e\)-forming the, which replaces the simple rule in (43) above. We have already defined \(e\)-forming the using the iota operator:

\[
\|\text{the dog}\| = \mathbf{tx}(\text{DOG}(x))
\]

Now to compose the denotation of NPs like the dog using functional application, we want a function that will make the translations illustrated in (48):

\[
\begin{align*}
\text{the dog} & \Rightarrow \mathbf{tx}(\text{DOG}(x)) \\
\text{the mushroom} & \Rightarrow \mathbf{tx}(\text{MUSHROOM}(x)) \\
\text{the rum baba} & \Rightarrow \mathbf{tx}(\text{RUM BABA}(x)) \\
\text{the predicate} & \Rightarrow \mathbf{tx}(\text{PREDICATE}(x))
\end{align*}
\]

Here we need a variable to represent predicates, not individuals. By convention the variables for predicates are capital letters \(P, Q,\) and \(R\). So now that we have variables to represent predicates (i.e., functions) we can analyse singular the as in (49):

\[
\|\text{the}\| = \lambda P(\mathbf{tx}(P(x)))
\]

As (49) shows, the is a function that takes a predicate as its argument. The composition of a noun phrase is shown in (50):

\[
\text{NP the dog:}
\]

- From the lexicon: \(\|\text{dog}\| = \lambda y[\text{DOG}(y)]\)
  \(\|\text{the}\| = \lambda P[\mathbf{tx}(P(x))]\)
- Functional application: \(\text{the(dog) } \lambda P[\mathbf{tx}(P(x))](\lambda y[\text{DOG}(y)])\)
- Lambda reduction: Place the argument = \(\lambda y[\text{DOG}(y)]\) in the \(P\) position, and delete \(\lambda P\) and the outer brackets. \(\Rightarrow \mathbf{tx}(\lambda y[\text{DOG}(y)](x))\)
- Lambda reduction inside the scope of iota:
  \[
  \mathbf{tx}\left(\lambda y[\text{DOG}(y)](x)\right) \Rightarrow \mathbf{tx}(\text{DOG}(x))
  \]

In the previous section the Intersective Modifier Rule was not stated in the form of functional application, but with predicate variables available we can clarify that point. In the simple analysis for blue umbrella both blue and umbrella were assigned their usual type \(<e, t>\), and given the functions \(\lambda x[\text{BLUE}(x)]\) and \(\lambda x[\text{UMBRELLA}(x)]\). In fact this gives an ill-formed combination as neither expression is of the form to take the other as its argument. In addition, the previous analysis did not differentiate between the modifier and the modified expression.
With predicate variables we can define **intersective modifiers**, including **modifier adjectives**, more explicitly – this discussion can replace the simple rule in (39) above.

An adjective like *red* in *The car Jones liked was red* is called a **predicative adjective** and generally appears in the syntactic predicate of the sentence. A predicative adjective is of type <e, t> (red, flat, tasty) or type <e, <e, t>> (proud, fond, afraid). A modifier adjective, on the other hand, is like the underlined adjectives in *the red hat, his last thought, and any old iron*, where *red* modifies the predicate *hat*, *last* modifies the predicate *thought*, and *old* modifies the predicate *iron*. A modifier adjective takes a predicate as its argument and forms a predicate of the same type. The different kinds of adjectives are illustrated in (51), where modifier *blue* is of type <<e, t>, <e, t>>:

(51) a. predicative adjective: *The umbrella is blue.* \(\llbracket\text{blue}\rrbracket = \lambda x[\text{BLUE}(x)]\)

b. Modifier adjective: *a blue umbrella.* \(\llbracket\text{blue}\rrbracket = \lambda P[\lambda x[\text{BLUE}(x) & P(x)]]\)

In the phrase *blue umbrella* the modifier *blue* is a function which takes *umbrella* as its argument.

(52) \(\lambda P[\lambda x[\text{BLUE}(x) & P(x)]] \quad \lambda y[\text{UMBRELLA}(y)]\)

Lambda reduction \(\Rightarrow \lambda x[\text{BLUE}(x) & \lambda y[\text{UMBRELLA}(y)] \ (x)]\)

\(\Rightarrow \lambda x[\text{BLUE}(x) & \text{UMBRELLA}(x)]\)

The analysis of a predicate nominal containing a modifier is illustrated in (53). Note in the tree diagram that the modifier *spotted* attaches inside the noun phrase at a node which is higher than the single noun N and lower than the full noun phrase NP. This node is N′, pronounced ‘N-bar’.

(53) Cruella stole the spotted dog.

**From the lexicon:**

\(\llbracket\text{Cruella}\rrbracket = c\)

\(\llbracket\text{steal}\rrbracket = \lambda y[\lambda x[\text{STEAL}(x, y)]]\)

\(\llbracket\text{the}\rrbracket = \lambda P[\lambda x[P(x)]]\)

\(\llbracket\text{spotted}_{\text{mod}}\rrbracket = \lambda P[\lambda x[\text{SPOTTED}(x) & P(x)]]\)

\(\llbracket\text{dog}\rrbracket = \lambda x[\text{DOG}(x)]\)

**Terminal Node Rule:**

\(\llbracket\text{N}\rrbracket = \llbracket\text{N}\rrbracket = \llbracket\text{Cruella}\rrbracket = c\)

\(\llbracket\text{V}\rrbracket = \llbracket\text{steal}\rrbracket = \lambda y[\lambda x[\text{STEAL}(x, y)]]\)

\(\llbracket\text{Det}\rrbracket = \llbracket\text{the}\rrbracket = \lambda P[\lambda x[P(x)]]\)

\(\llbracket\text{A}\rrbracket = \llbracket\text{spotted}_{\text{mod}}\rrbracket = \lambda P[\lambda x[\text{SPOTTED}(x) & P(x)]]\)

\(\llbracket\text{N}_2\rrbracket = \llbracket\text{dog}\rrbracket = \lambda x[\text{DOG}(x)]\)

**Non-Branching Node Rule:**

\(\llbracket\text{NP}\rrbracket = \llbracket\text{N}\rrbracket = \llbracket\text{Cruella}\rrbracket = c\)

\(\llbracket\text{AP}\rrbracket = \llbracket\text{A}\rrbracket = \llbracket\text{spotted}_{\text{mod}}\rrbracket = \lambda P[\lambda x[\text{SPOTTED}(x) & P(x)]]\)
With the use of predicate variables we can also define the determiner _a/an_ in a predicate noun phrase. (Note that _a/an_ has more than one meaning and this definition only applies to _a/an_ in a predicate.) An example of a predicate nominal and the definition for predicate _a/an_ are given in (54):

(54) Alison is a dentist. \[a_{\text{an}_{\text{pred}}}] = \lambda P[P]\]

The function \(\lambda P(P)\) takes the predicate denoted by the noun as its argument:

(55) \(a \text{ dentist} \) \(= \lambda P[P] (\lambda x[DENTIST(x)])\)

\[\lambda P[P] (\lambda x[DENTIST(x)]) \Rightarrow \lambda x[DENTIST(x)]\]

Following lambda reduction, the newly formed expression is the same as the predicate denoted by the noun. This gives the same result as our previous strategy of simply omitting _a/an_. An example of meaning composition for a
sentence with predicate *alan* is given in (56). (As in (46) above, I will continue to treat the copula *be* as a piece of uninterpreted syntax here, but see Exercise 10 for an alternative.)

(56) Alison is a dentist.

**From the lexicon:**

\[ \| Alison \| = a \]

\[ \| \textit{dentist} \| = \lambda x [\text{DENTIST}(x)] \]

\[ \| \textit{an}_{pred} \| = \lambda P[P] \]

**Terminal Node Rule:**

\[ \| N_1 \| = \| Alison \| = a \]

\[ \| N_2 \| = \| \textit{dentist} \| = \lambda x [\text{DENTIST}(x)] \]

\[ \| \textit{Det} \| = \| \textit{an}_{pred} \| = \lambda P[P] \]

**Non-branching Node Rule:** Assuming that the verb is a piece of uninterpreted syntax, VP counts as a non-branching node and \[ \| VP \| = \| NP_2 \| \]

\[ \| S \| = \| \text{DENTIST}(a) \|

Functional application \( VP(NP_1) \)

\[ \lambda x [\text{DENTIST}(x)](a) \]

Lambda reduction

Non-branching node Rule

\[ \| NP_2 \| = \lambda x [\text{DENTIST}(x)] \]

Functional application: \( \textit{Det}(N) \)

\[ \lambda P[P](\lambda x [\text{DENTIST}(x)]) \]

Lambda reduction

---

**Summary of rules and definitions**

**Basic – individual variables only**

**Types**

- entity \( e \)
- proposition \( t \)
1-place predicate <e, t>
2-place predicate <e, <e, t>>
3-place predicate <e, <e, <e, t>>>
modifier of 1-place predicate: <<e, t>, <e, t>>>

Functions
1-place cough \(\lambda x[\text{COUGH}(x)]\)
2-place like \(\lambda y[\lambda x[\text{LIKE}(x, y)]]\)
3-place give \(\lambda z[\lambda y[\lambda x[\text{GIVE}(x, y, z)]]]\)

Terminal Node Rule: The interpretation of a terminal node is taken from the lexicon.

Non-branching Node Rule: The denotation of a non-branching node is the same as the denotation of its single daughter.

Branching node: A branching node is interpreted by Functional Application.

Simplified Intersective Modifier Rule: \(\llbracket A_{<e, t>} + B_{<e, t>} \rrbracket = \lambda x[A(x) \& B(x)]\)

Simplified Restrictive Relative Clause Rule: \(\lambda\)-abstract the relativized argument.

\(\llbracket \text{who gave the parcel to Donald} \rrbracket = \lambda x[\text{GIVE}(x, \text{the parcel, d})]\)
\(\llbracket \text{that Harriet gave to Donald} \rrbracket = \lambda x[\text{GIVE}(h, x, d)]\)
\(\llbracket \text{to whom Harriet gave the parcel} \rrbracket = \lambda x[\text{GIVE}(h, \text{the parcel, x})]\)

Simple Rule for e-forming the: \(\llbracket \text{the} P \rrbracket = tx(P(x))\)

Assigning a constant to e-type NP (to simplify representation): \(tx(P(x)) = a\)

Including Predicate variables

e-forming the: \(\llbracket \text{the}_{\text{form}} \rrbracket = \lambda P[tx(P(x))]\)

Predicative Adjective: \(\lambda x[P(x)]\)
\(\llbracket \text{The umbrella is blue.}\rrbracket = \lambda x[\text{BLUE}(x)]\)

Modifier Adjective: \(\lambda P[P(x) \& \text{ADJ}(x)]\)
\(\llbracket \text{A blue umbrella.}\rrbracket = \lambda P[\lambda x[P(x) \& \text{BLUE}(x)]]\)

Predicate Nominal \(\text{a/an}_{\text{pred}}: \llbracket \text{a/an}_{\text{pred}} \rrbracket = \lambda P[P]\)

EXERCISES

A. Types

(1) *

Give the type of the underlined expressions in the sentences below. The first one is done as an example.

a. Adela saw Peter.

b. Adela saw Peter.
c. Rupert wore checked trousers.
d. The wall was very high.
e. Harry allowed the hamsters three nuts each.
f. The wall was very high.
g. This guy came up to me.

(2) **
As for (1), give the types for the underlined expressions. Some of the examples here contain types that were not discussed in the chapter, but can be calculated. (Determine the type that the expression combines with $= a$; the type of the newly formed expression $= b$: the expression is of type $<a, b>$.)

a. Snails don’t like mustard.
b. The men worked slowly.
c. Snails don’t like those yellow flowers.
d. Snails might like brown mustard, but it seems unlikely.
e. The cache was in the cellar.
f. Calpurnia interleaved the roses with laurel leaves.
g. Calpurnia carefully wove the wreath.

Types and lambda functions

(3) *
Construct semantic trees for the sentences below, using the left-hand trees in Examples (29) and (30) in the chapter as a guide.

a. Fred coughed.
b. Peter saw Katrina.
c. Gertie assigned Quentin to Maud.

(4) **
Follow the instructions for Exercise (3).

a. Gertie read the black book.
b. Millie described the strange mushroom that she found.
   (Assume that she refers to Millie.)
c. The man who killed Abel was notorious.
d. The stag patrolled the deep valley.

Composing truth conditions

(5) *
Construct analyses for the sentences below using the principles of semantic composition outlined in Section 4.5. Use the trees in (45)–(46) as a guide.

a. Katya met James.
b. Cain killed Abel.
c. Lucy bequeathed Methuselah to Quentin.
d. Jones fed the cat.
e. The white cat bit Kerry.
f. The dog died.
g. The brown dog loves Leo.
h. Matt wore the black hat.

Connectives

(6) ***
Consider the underlined expressions in the sentences below.

a. Jones left and Stedman locked the door.
b. Lucy made muffins or James made tiramisu.

(i) Determine the types of these expressions.
(ii) In order to assign a well-formed type to these expressions, you have to make certain assumptions about the form of the syntactic trees. Draw the trees for (a) and (b). (Hints: The tree must be binary branching. Although it is sometimes considered bad style, and and or can appear at one end of a sentence, but not at the other end.)

(iii) Write a \( \lambda \)-function for each expression.

(7) ** (Including predicate variables, up to and including Section 4.6.)
Construct analyses for the sentences below using the principles of semantic composition outlined in Section 4.5, and the rules for the, predicate \( a/an \), and modifier adjectives in 4.6. Use the trees in Examples (45), (46), (53), and (56) in the chapter as a guide. (Use the ‘=’ sign to represent identity.)

a. Jones is a beachcomber.
b. The red balloon was magic.
c. The black dog is Jet.
d. Brian sent Jones the old photograph.
e. Gary groomed the grey pony.

(8) ** (Including predicate variables, up to and including Section 4.6.)
Follow the instructions for Exercise 6.

a. Anne devoured the delicious rum baba.
b. Chris made the wooden bowl.
c. Jet is a black dog.
d. Jonah gave the valuable painting to Drusilla.
e. The steep cliff contained the hidden entrance.

(9) *** (Including predicate variables, up to and including Section 4.6.)
Follow the instructions for Exercise 6.

a. The man who fed Midge knows Kevin.
c. The woodcutter was a talkative old man.
d. The man that Anne met is Herbert.
e. Jones is the man that Lucinda married.

f. The black hat which was on the bed alarmed Matt.

g. The sheep that Brian sheared is a merino.

**Copula be**

(10) **(Including predicate variables, up to and including Section 4.6.)**

We have been treating the copula verb *be* as a piece of uninterpreted syntax. Alternatively, copula *be* can be defined as:

$\langle be_{op}\rangle = \lambda P[\lambda x[P(x)]]$

Using this definition where appropriate, construct meaning composition trees (see Exercises 5 and 6) for the sentences below.

a. Bruce is a friendly sheepdog.
b. Ramon is the man who married Judith.
c. Wilbur is a talking pig.

**FURTHER READING**

More advanced and detailed introductions to formal semantics are Chierchia and McConnell-Ginet (1990) and Cann (1993).

For a more advanced introduction to formal semantic theory allied to transformational grammar, and with particular attention to syntactic issues, see Heim and Kratzer (1998).

Portner (2005) presents a largely non-formalized introduction to the main ideas and analytic techniques of formal semantics, including ‘Modelling properties with sets and functions’, pp. 54–9.

The binary verb phrase in syntax was introduced in Larson (1988). This is an advanced syntactic theory paper, but not inaccessible. Carnie (2007) Chapter 13 provides an introduction to the more complex verb phrase structure. This is a syntax text which assumes some background in transformational grammar.

Compositional semantics requires an appropriate syntax to parallel the semantic types. The shapes of tree diagrams used in compositional semantics are generally the same as those used in general syntax, but semanticists also label nodes in the tree with a finer categorization of lexical classes to match the types. For example, the category of verbs is divided into intransitive verbs (IV) of type $<e, t>$; transitive verbs (TV) of type $<e, <e, t>>$; and ditransitive verbs (DV) of type $<e, <e, <e, t>>>$. Nouns are divided into (at least) common nouns (CN) and names (N). For these categories see Heim and Kratzer (1998).
In this chapter we will see how the logical quantifiers, introduced in Chapter 3, and possible worlds, introduced in Chapter 1, are used to analyse modality. In Section 5.3 we will also see how possible worlds can be used to clarify the relationship between a certain kind of conditional statement and material implication, introduced in Chapter 2.

5.1 Kinds of modality

Modality expresses necessity and possibility. A modal proposition includes the information that the basic proposition it contains is necessarily or possibly true. A necessarily true proposition is one which is true in any circumstances whatsoever, and cannot be false. A possibly true proposition is one which may or may not be true in fact, but is not necessarily false. Modality modifies the interpretation of a whole proposition, and so takes scope over a proposition. Modality is represented by a symbol at the beginning of the proposition:

(1) necessity operator □: ‘necessarily p’ is written as □p

possibility operator ◊: ‘possibly p’ is written as ◊p

In English, modality is most commonly expressed by the modal verbs shall, should, can, could, may, might, would and must, and sometimes will, and by adverbs like possibly, maybe, perhaps and necessarily. These expressions will be illustrated below.

5.1.1 Logical modality

Logical modality concerns all the possibilities for a proposition to be true, limited only by the requirements of logic.

Logical necessity is illustrated in (2) below. The examples in (2a–d) are paraphrases of a modal proposition, which is separated in (2e) into modal necessity – the operator □ – and the non-modal proposition which it modifies.
(2) a. Necessarily, the diameter of a circle passes through the centre of the circle.
b. It is necessarily the case that the diameter ...
c. It must be the case that the diameter ...
d. The diameter of a circle must pass through the centre of the circle.
e. □ (The diameter of a circle passes through the centre of a circle)

The modal statements in (2a–d) all express the proposition that the contained proposition ‘The diameter of a circle passes through the centre of the circle’ is necessarily true – it is not possible for this contained proposition to be false, in any circumstances. ‘The diameter of a circle passes through the centre of a circle’ is indeed necessarily true, and so the proposition expressed in (2) is true. Because ‘The diameter of a circle passes through the centre of the circle’ is necessarily true, obviously it is true in actuality – any necessarily true proposition is true in fact, because it is impossible for it to be false.

**Logical possibility** is illustrated in (3) and (4) below. As before, in (3c) and (4c) the proposition is separated into modal possibility – the operator ◊ – and the non-modal proposition which it modifies.

(3) a. Napoleon might have won at Waterloo.
b. For Napoleon to have won at Waterloo was possible.
c. ◊ Napoleon won at Waterloo

(4) a. It is possible for there to be a man who is older than his own uncle.
b. There can be a man who is older than his own uncle.
c. ◊ (There is a man who is older than his own uncle)

A statement of logical possibility states that the truth of the contained proposition is compatible with the requirements of logic, and so the contained proposition is not necessarily false – logic allows it to be true. Whether or not the contained proposition is true in fact can vary. The modal statement in (3) is true, as it was possible for Napoleon to have won at Waterloo. In fact we know that Napoleon was defeated at Waterloo and ‘Napoleon won at Waterloo’ is false, but if reality had developed differently he might have won. The modal statement in (4) is also true, as it is perfectly possible for ‘There is a man who is older than his own uncle’ to be true. Here the contained proposition is also true in fact, as there are many large families in which the described circumstance holds.

### 5.1.2 Epistemic modality

**Epistemic modality** is so-called because it concerns what is known, from the Greek *epistēmē*, meaning ‘knowledge’. Epistemology is the branch of philosophy which explores the nature of knowledge. Epistemic modality expresses the necessity or possibility of a proposition’s being true in fact, *given what is already known*. In other words, epistemic modal statements express conclusions drawn from the actual evidence about the range of possibilities for what is the case in reality.
Epistemic necessity is illustrated in (5):

\[(5) \quad \begin{align*}
\text{a.} & \quad \text{The dinosaurs must have died out suddenly.} \\
\text{b.} & \quad \Box_{\text{epistemic}}(\text{The dinosaurs died out suddenly})
\end{align*}\]

What is expressed in (5) could be paraphrased as ‘Given what we already know, it must be the case that the dinosaurs died out suddenly’, or ‘The evidence we have leads to the inescapable conclusion that the dinosaurs died out suddenly’. Epistemic necessity expresses what follows from our present knowledge, which may be incomplete. So epistemic necessity, unlike logical necessity, doesn’t guarantee that the contained proposition is true in fact. Even if we take (5) as true, we can’t thereby take it for granted that the dinosaurs died out suddenly.

Epistemic possibility is illustrated in (6):

\[(6) \quad \begin{align*}
\text{a.} & \quad \text{There might/could be intelligent life in deep space.} \\
\text{b.} & \quad \text{It is possible that there is intelligent life in deep space.} \\
\text{c.} & \quad \text{There is possibly intelligent life in deep space.} \\
\text{d.} & \quad \Diamond_{\text{epistemic}}(\text{There is intelligent life in deep space})
\end{align*}\]

The proposition expressed in (6) is that the truth of ‘There is intelligent life in deep space’ is compatible with our present knowledge. To say (6) is to speculate about how the actual universe might be in fact, not about how it might have been had things been otherwise than they are. Assuming that (6) is true, what we know now about the evolution of life on this planet is compatible with a similar scenario having unfolded elsewhere in the universe, but we don’t know whether or not that has in fact happened. In reasoning from the evidence in hand to the conclusion that ‘There is intelligent life in deep space’ is possibly true, we have to obey the requirements of logic, so ‘There is intelligent life in deep space’ is also logically possible. Epistemic possibility includes logical possibility.

Until recently the modal form may have (done) was used only for epistemic modality, although might have (done) can be logical or epistemic. The contrast is shown in (7):

\[(7) \quad \begin{align*}
\text{logical possibility} & \quad \begin{align*}
\text{a.} & \quad \text{She might have fallen down the cliff – thank goodness the safety harness held.} \\
\text{b.} & \quad \text{#She may have fallen down the cliff – thank goodness the safety harness held.}
\end{align*} \\
\text{epistemic possibility} & \quad \begin{align*}
\text{c.} & \quad \text{She may have fallen down the cliff – we’re still waiting for the rescue team’s report.} \\
\text{d.} & \quad \text{She might have fallen down the cliff – we’re still waiting for the rescue team’s report.}
\end{align*}
\end{align*}\]

This distinction seems to be disappearing. A headline such as Pilot may have averted crash is now ambiguous: on the epistemic interpretation, evidence now
reveals that a plane which did not crash may have been in danger which was averted by the pilot’s action. On the emerging non-epistemic interpretation, the plane did crash but the pilot could have prevented it had things happened differently. A somewhat bizarre example of this shift is the headline *GP Criticized over Death: Baby may have lived — Coroner.*

5.1.3 Deontic modality

Modal auxiliaries also express **deontic modality**, which is concerned with compliance or compatibility with some code of behaviour or set of rules. Which code or set of rules is involved depends on the context and is determined pragmatically. **Deontic necessity** expresses what is required or compulsory, or what someone is obliged to do within the set of rules determined by the context, and **deontic possibility** expresses what is allowed or permitted within the rules. These are illustrated in (8) and (9):

(8) **deontic necessity**
   a. You must be home by midnight.
      \( \Box_{\text{deontic}} \) (You will be home by midnight)
      (Rules: What your mother says.)
   
   b. Buildings erected after September of this year are required to comply with the Revised Building Code.
      \( \Box_{\text{deontic}} \) (Buildings erected after September of this year will comply with the Revised Building Code)
      (Rules: Local body regulations.)

(9) **deontic possibility**
   a. Visitors may use the downstairs sitting room after 6 p.m.
      \( \Diamond_{\text{deontic}} \) (Visitors use the downstairs sitting room after 6 p.m.)
      (Rules: Regulations in a student hostel.)
   
   b. Harry is allowed to drive the tractor.
      \( \Diamond_{\text{deontic}} \) (Harry drives the tractor)
      (Rules: What the farmer says.)

5.2 Modality and possible worlds

The symbols \( \Box \) and \( \Diamond \), like negation and the connectives, do not in themselves constitute definitions, but require definitions. The connectives and negation are defined in truth tables, and modality is defined with reference to possible worlds.

Recall that a logically necessary proposition is true in any circumstances whatsoever. The circumstances in question are alternative ways reality might have been – for example, no matter how reality might have been, the diameter of a circle passes through its centre. For a proposition which is logically possibly true there are circumstances in which it would be true, even if it isn’t
true in fact. For example, given at least one other way things might have gone, Napoleon might have won at Waterloo. As outlined in Sections 1.3.2–3, these alternative ways of reality are possible worlds.

The discussion of possible worlds in Chapter 1 implied that there is just one set of all the possible worlds, with infinitely many members, and that semantics works with that set. The term *possible world* tells us only that worlds which are possible are in the set. In fact a bit more detail than this is needed for the different kinds of natural language modality, which do not all use the full set of worlds.

### 5.2.1 Logical modality and possible worlds

Logical modality works with the full set of worlds. A logically necessary proposition is true in any possible circumstances whatsoever, which is the same as being true in all possible worlds. A logically possible proposition is true in at least one possible set of circumstances, even if it isn’t true in fact. Accordingly, logical necessity and possibility are analysed as in (10) and (11). The \( w \) variable is a restricted variable, and can only have worlds as its value.

\[
(10) \quad \text{logical necessity:} \quad \Box p \leftrightarrow \forall w (p \text{ is true in } w)
\]

*Necessarily the diameter of a circle passes through its centre.*

\( \Box (\text{The diameter of a circle passes through its centre}) \leftrightarrow \forall w (\text{‘The diameter of a circle passes through its centre’ is true in } w) \)

Read as: ‘Necessarily the diameter of a circle passes through its centre’ is true if and only if for every possible world \( w \) ‘The diameter of a circle passes through its centre’ is true in \( w \).

\[
(11) \quad \text{logical possibility:} \quad \Diamond p \leftrightarrow \exists w (p \text{ is true in } w)
\]

*Napoleon might have won at Waterloo.*

\( \Diamond (\text{Napoleon won at Waterloo}) \leftrightarrow \exists w (\text{‘Napoleon won at Waterloo’ is true in } w) \)

Read as: ‘Napoleon might have won at Waterloo’ is true if and only if there is at least one possible world \( w \) such that ‘Napoleon won at Waterloo’ is true in \( w \).

### 5.2.2 Epistemic modality and possible worlds

Epistemic modality is defined in terms of *epistemically possible worlds*. An epistemically possible world is one in which everything we know about the actual world also holds – we don’t know of any differences between the actual world and any epistemically possible world (even though there might be differences). For all we know, any epistemically possible world IS reality. In the definition below the variable \( w_e \) ranges over epistemically possible worlds.

\[
(12) \quad \text{epistemic necessity:} \quad \Box_{epistemic} p \leftrightarrow \forall w_e (p \text{ is true in } w_e)
\]

*The gods must be crazy.*
Epistemic must conveys that all the evidence we have about some real situation leads to an inescapable conclusion, but it is far weaker than logical necessity. The gods must be crazy may be true interpreted epistemically, but even if it is, there are infinitely many logically possible worlds where the gods are sane and wise, and thus The gods must be crazy interpreted as logical necessity is false.

Epistemic possibility is analysed as in (13).

\[ \square_{\text{epistemic}} \text{(The gods are crazy)} \leftrightarrow \forall w_e ('\text{The gods are crazy'} \text{ is true in } w_e) \]

Read as: ‘The gods must be crazy’ is true if and only if for every epistemically possible world \( w_e \) ‘The gods are crazy’ is true in \( w_e \).

(13) epistemic possibility general rule
\[ \diamond_{\text{epistemic}} p \leftrightarrow \exists w_e (p \text{ is true in } w_e) \]

She may have fallen down the cliff.
\[ \diamond_{\text{epistemic}} (\text{She fell down the cliff}) \leftrightarrow \exists w_e ('\text{She fell down the cliff'} \text{ is true in } w_e) \]

Read as: ‘She may have fallen down the cliff’ is true if and only if there is at least one epistemically possible world \( w_e \) such that ‘She fell down the cliff’ is true in \( w_e \).

According to the definition in (13), what we know about the actual circumstances is consistent with her having fallen down the cliff, and we could subsequently discover that she did fall in fact, or that she did not.

5.2.3 Deontic modality and possible worlds

Deontic modality can also be analysed in terms of possible worlds, but in this case the possible worlds at issue are the ones in which the relevant code of behaviour (for example, the ten commandments, the Confucian code, what your mother says) is always completely adhered to. A deontically necessary action or course of events is found in all such perfect obedience worlds. A permissible action or course of events is found in at least one such world – that is, perfect obedience is compatible with what is permitted, but doesn’t require it. In the definitions in (14) and (15), the variable \( w_{po} \) stands for perfect obedience worlds:

\[ \square_{\text{deontic}} p \leftrightarrow \forall w_{po} (p \text{ is true in } w_{po}) \]

Children must be seen and not heard.
\[ \square_{\text{deontic}} (\text{Children are seen and not heard}) \leftrightarrow \forall w_{po} ('\text{Children are seen and not heard'} \text{ is true in } w_{po}) \]

Read as: ‘Children must be seen and not heard’ is true if and only if for every perfect obedience world \( w_{po} \) ‘Children are seen and not heard’ is true in \( w_{po} \).

\[ \diamond_{\text{deontic}} p \leftrightarrow \exists w_{po} (p \text{ is true in } w_{po}) \]

A cat may look at a king.
\[ \diamond_{\text{deontic}} (\text{A cat looks at a king}) \leftrightarrow \exists w_{po} ('\text{A cat looks at a king'} \text{ is true in } w_{po}) \]
Read as: ‘A cat may look at a king’ is true if and only if there is at least one perfect obedience world \( w_{po} \) such that ‘A cat looks at a king’ is true in \( w_{po} \).

The sayings in (14) and (15) are generalizations, and seem to be adequately defined in terms of all the perfect obedience worlds for the code of behaviour at issue, the relevant code being identified by pragmatic knowledge. However, with a statement of deontic necessity that involves a particular or particular individuals, as in ‘Jones must leave town within 24 hours’, we evidently need a greater pragmatic contribution to identifying the possible worlds at issue. In particular, the relevant worlds are those perfect obedience worlds which also contain any particular circumstances or individuals that are referred to in the deontic statement. For example, ‘Jones must leave town within 24 hours’ is true iff ‘Jones leaves town within 24 hours’ in all the perfect obedience worlds where Jones and the relevant circumstances are reproduced, including the time from which the 24 hours are counted.

There isn’t a sharp division between deontic statements that do, and deontic statements that do not require more detailed specification of the kinds of perfect obedience worlds in terms of which they are defined. One possible way to cover the need for extra pragmatic information is to adopt a rule like (16):

\[
\Box_{\text{deontic}} p \leftrightarrow \forall_{w_{po}} \left( w_{po} \text{ is relevantly similar to the actual world } \rightarrow p \text{ is true in } w_{po} \right)
\]

A possible world that is relevantly similar to the actual world contains all those features of the actual world that are pragmatically identified as being needed in the perfect obedience worlds as well – in the example above, this would include Jones and the circumstances that make his departure obligatory. (Relevant similarity is also discussed in Section 5.3.)

The possible worlds analysis reviewed so far captures two key properties of modal sentences. First, the use of possible worlds captures the fact that modal sentences are about hypothetical states of affairs, and not simply descriptive of actual reality. Second, the use of existential and universal quantification gives an elegant account of the way that necessity can be defined in terms of possibility and negation, and possibility can be defined in terms of necessity and negation, as reviewed in the next section.

**5.2.4 Interdefinability with negation**

Necessity and possibility are opposed in such a way that each can be paraphrased using the other, with negation, as shown in (17).

\[
\begin{align*}
(17) \quad & a. \, \Box p \quad \text{It is necessarily the case that } p \\
& \sim\Diamond p \quad \text{It is not possibly the case that not } p \\
\quad & b. \, \Diamond p \quad \text{It is possibly the case that } p \\
& \sim\Box \sim p \quad \text{It is not necessarily the case that not } p
\end{align*}
\]
c. \(\Box\neg p\) It is necessarily the case that not \(p\)
\(\neg \Diamond p\) It is not possibly the case that \(p\)
d. \(\Diamond \neg p\) It is possibly the case that not \(p\)
\(\neg \Box p\) It is not necessarily the case that \(p\)

English sentences to illustrate these patterns are given in (18)–(20). They don’t sound equally natural, and it isn’t always possible to negate a sentence by simply adding *not*.

(18) **logical modality**

\(\Box p\) A circle’s diameter must pass through its centre.
\(\neg \Diamond p\) The diameter of a circle can’t not pass through the circle’s centre.
\(\neg \Box p\) It is not possible for the diameter of a circle to not pass through the centre of the circle.

\(\Diamond p\) Terry might have hit the bullseye.
\(\neg \Box \neg p\) Terry need not have missed (not hit) the bullseye.
\(\neg \Box \neg p\) It wasn’t inevitable for Terry to not hit the bullseye.

\(\Box p\) Necessarily parallel lines do not meet.
\(\neg \Diamond p\) Parallel lines cannot meet.
\(\neg \Box p\) It is not possible for parallel lines to meet.

\(\Diamond \neg p\) The dinosaurs might not have died out.
\(\neg \Box \neg p\) It might have turned out that the dinosaurs didn’t die out.
\(\neg \Box \neg p\) It wasn’t inevitable for the dinosaurs to die out.

(19) **epistemic modality**

\(\Box p\) The dinosaurs must have died out suddenly.
\(\neg \Diamond \neg p\) It can’t be that the dinosaurs didn’t die out suddenly.
\(\neg \Box \neg p\) The dinosaurs can’t have not died out suddenly.
\(\neg \Box \neg p\) It is not possible that the dinosaurs did not die out suddenly.

\(\Diamond p\) There could be intelligent life in deep space.
\(\neg \Box \neg p\) It need not be the case that there is no intelligent life in deep space.
\(\neg \Box \neg p\) It is not necessarily the case that there is no intelligent life in deep space.

\(\Box \neg p\) He must have not seen the note.
\(\neg \Diamond \neg p\) It must be the case that he didn’t see the note.
\(\neg \Box \neg p\) He can’t have not seen the note.
\(\neg \Box \neg p\) It is not possible that he saw the note.

(Perhaps he was in a hurry ...)

\(\Diamond \neg p\) He might have not read the note.
\(\neg \Box \neg p\) It is possible that he didn’t read the note.
\(\neg \Box \neg p\) He needn’t have read the note.
\(\neg \Box \neg p\) It needn’t be so that he read the note.
\(\neg \Box \neg p\) It isn’t necessarily the case that he read the note.
(20) **deontic modality**

Assume that \( p = \) He leaves town

\( \neg p = \) He does not leave town/He stays in town.

\( \Box p \) He must leave town

He is obliged to leave town.

\( \neg \Diamond \neg p \) He may not stay in town.

He may not not leave town.

He is not permitted to stay in town.

He is not permitted to not leave town.

\( \Diamond p \) He may leave town.

\( \neg \Box \neg p \) He need not not leave town.

He need not stay in town.

He is not obliged to not leave town.

\( \Box \neg p \) He must not leave town.

What he must do is not leave town.

He must stay in town.

He is obliged to not leave town.

\( \neg \Diamond p \) He may not leave town.

He is not permitted to leave town.

\( \Diamond \neg p \) He may stay in town.

He may not leave town.

What he may do is not leave town.

\( \neg \Box p \) He need not leave town.

He is not obliged to leave town.

As we saw in Chapter 3, existential and universal quantification are related in the same way. For any universally quantified proposition there is an equivalent existentially quantified proposition with negation, and vice versa. Examples illustrating this are repeated in (21) and (22) below. (21a, b) are equivalent, and (22a, b) are equivalent.

(21)  

a. \( \forall x (\text{DOG}(x) \rightarrow \text{BARK}(x)) \)

‘For every \( x \), if \( x \) is a dog then \( x \) is barking’

b. \( \neg \exists x (\text{DOG}(x) \& \neg \text{BARK}(x)) \)

‘There is no \( x \) such that \( x \) is a dog and \( x \) is not barking’

(22)  

a. \( \exists x (\text{DOG}(x) \& \text{BARK}(x)) \)

‘There is an \( x \) such that \( x \) is a dog and \( x \) is barking’

b. \( \neg \forall x (\text{DOG}(x) \rightarrow \neg \text{BARK}(x)) \)

‘It is not the case that for all \( x \), if \( x \) is a dog then \( x \) is not barking’

The schematic representations below show that, in the possible worlds analysis of modality, the interdefinability of necessity and possibility follows automatically from the interdefinability of universal and existential quantification.
(23) a. □p  It is necessarily the case that p
\[ \forall w(p \text{ is true in } w) \]
\[ \sim \Diamond \sim p \]  It is not possibly the case that not p
\[ \sim \exists w(\sim p \text{ is true in } w) \]
b. \Diamond p  It is possibly the case that p
\[ \exists w(p \text{ is true in } w) \]
\[ \sim \Box \sim p \]  It is not necessarily the case that not p
\[ \sim \forall w(\sim p \text{ is true in } w) \]
c. \Box \sim p  It is necessarily the case that not p
\[ \forall w(\sim p \text{ is true in } w) \]
\[ \sim \exists w(p \text{ is true in } w) \]
d. \Diamond \sim p  It is possibly the case that not p
\[ \exists w(\sim p \text{ is true in } w) \]
\[ \sim \Box p \]  It is not necessarily the case that p
\[ \sim \forall w(p \text{ is true in } w) \]

5.3 Counterfactuals

We saw in Chapter 2 that the implication connective $\rightarrow$ fits for some uses of English if... (then) but not all. The two most striking differences are that (i) English if... (then) statements commonly express a causal relationship, but any logical connective simply specifies combinations of truth values, and (ii) according to the truth table for $\rightarrow$, when the antecedent is false the whole implication is true, no matter what the consequent is. Because of the second point, generally only the first two lines of the truth table give the expected results for if-sentences.

(24)

\[ p \quad q \quad p \rightarrow q \]
\[
\begin{array}{ccc}
\text{line 1} & T & T & T \\
\text{line 2} & T & F & F \\
\text{line 3} & F & T & T \\
\text{line 4} & F & F & T \\
\end{array}
\]

The anomalousness of lines 3 and 4 is clearly illustrated with counterfactual conditionals, which are conditionals with false antecedents, like (25). (This example is from Lewis (1973).)

(25) a. If kangaroos had no tails they would topple over.
b. If kangaroos had no tails they would not topple over.

Kangaroos have tails, so the antecedent shared by both (25a) and (25b) is false. According to the truth table for implication both (25a, b) are true, and yet they contradict each other. Plausibly, (25a) is true and (25b) false.
Now to assign the value False to the antecedent and work from there is to judge the statement according to the facts of reality. This is like responding to either statement with ‘But they do have tails’, and refusing to consider the matter further. A response like this misses the point, which is that a counterfactual makes a statement about hypothetical situations, not about how things really are.

Two things are needed here. First, the counterfactual must be interpreted in a way that acknowledges its hypothetical character. Second, if (25a) is true and (25b) is false, which seems correct, the difference between them must depend on the consequent, because they have the same antecedent. Both these points can be taken into account if the interpretation is based on lines 1 and 2 of the truth table.

To bring lines 1 and 2 into play we make the antecedent true, which is simply a matter of moving to possible worlds in which kangaroos have no tails. So imagine those worlds with tailless kangaroos leaping about. If there are any worlds in which they don’t topple over, then ‘If kangaroos had no tails they would topple over’ is false. But if the tailless kangaroos in all those worlds do topple over, then ‘If kangaroos had no tails they would topple over’ is true. In the appropriate worlds, the first two lines of the truth table give the right result.

If in considering the tailless kangaroo worlds you decided that they do topple over, you co-operated with the hypothesis in a number of important respects, by considering worlds which also contain other relevant features carried over from reality. But the range of tailless kangaroo worlds also includes these:

(26) w1 Kangaroos have no tails. Earth’s gravity is less than that of the real moon and kangaroos leap over its surface without toppling over.

w2 As kangaroos evolved and their tails disappeared, they developed a walking gait, moving the feet alternately. They don’t topple over.

w3 As kangaroos evolved and their tails disappeared, their forelegs became longer and stronger. They developed a four-footed bounding gait. They don’t topple over.

w4 Kangaroos have no tails. When they are weaned they are issued with gas-powered jet thrusters mounted on a harness, connected to orientation sensors and a little computer. When a kangaroo leans too far from the vertical the jet thruster fires a burst to push it back upright. Kangaroos do not topple over.

These are worlds in which the conditional is false, with a true antecedent and a false consequent, and accordingly, ‘If kangaroos had no tails they would topple over’ is false – but only if these worlds are included in the analysis. But surely that would be unreasonable. If the counterfactual is to be given an appropriate interpretation, worlds like these must be excluded as irrelevant. The background
worlds must include only those worlds which are similar to the actual world in the relevant respects, in this case including at least gravity, kangaroos’ leaping gait and kangaroos’ small forelegs.

Specifying the right similar worlds is quite complicated, and will be discussed further below. For now the chief points of the analysis are expressed in the truth condition in (27): the constant $w_@$ stands for the actual world.

(27) Counterfactual general rule:

‘If $p$ then $q$’ is true $\iff \forall w((p \text{ is true in } w \& w \text{ is otherwise relevantly similar to } w_@) \rightarrow q \text{ is true in } w)$

‘If kangaroos had no tails they would topple over’ is true if and only if $\forall w((’Kangaroos have no tails’ is true in $w$ & $w$ is otherwise relevantly similar to $w_@$) $\rightarrow$ ’Kangaroos topple over’ is true in $w$)

Read as: ‘If kangaroos had no tails they would topple over’ is true if and only if for every possible world $w$ such that ‘Kangaroos have no tails’ is true in $w$ and $w$ is otherwise relevantly similar to the actual world, ‘Kangaroos topple over’ is true in $w$.

Once the relevantly similar worlds are selected and all the others are stripped away, the truth of the whole conditional depends on the consequent being necessarily true in relation to that set of worlds – the conditional is true if and only if the consequent is true in all of the selected worlds.

The possible worlds analysis has a number of advantages. It expresses the hypothetical nature of counterfactuals, in that possible worlds are hypothetical realms, and it excludes the troublesome lines 3 and 4 of the conditional truth table.

On the other hand, the analysis depends on identifying the right set of worlds in terms of being relevantly similar to reality. We can’t get a good analysis for counterfactuals in general unless we can state in general how relevant similarity works, but this can be quite complicated.

One way of excluding worlds with lower gravity or worlds with kangaroo jet boosters might be to stipulate that the worlds we want are like the actual world in every respect except for what the antecedent specifies. But this is too strict, because the taillessness of the kangaroos will also produce other unavoidable changes – for example, without tails the kangaroos would leave different tracks, and there would be no kangaroo tail soup. So we have to let in all the differences that follow directly from the lack of kangaroo tails.

We want to select worlds which, though they differ from actuality in matters of detail, are like the actual world in more important and more general ways. For one thing, the counterfactual expresses a hypothesis about the mechanics of kangaroo locomotion and balance. Here we have a creature which is functionally two-legged – the forelegs are not much used for weight-bearing. Several factors help to balance a leaping kangaroo, including the large landing surfaces of the elongated hind feet, the strength of the hind legs and the heavy tail as a counterweight. The hypothesis is that the other balance factors would be insufficient without tails as counterweights. The possible worlds we want must obey the general laws which govern these facts – perhaps we could ensure
that by saying that the similarity criteria for this counterfactual include the 
laws of nature.

Unfortunately, the kangaroos required to test the hypothesis are highly 
unnatural beasts. They have an extraordinary high-speed bounding gait, like 
a two-legged cheetah, and insufficient ways of keeping their balance. This 
scenario must presuppose very unusual patterns for the evolution of species. 
Given the laws of nature governing biology, a kangaroo like ours except for the 
tail would have evolved some way of not toppling over, by walking instead of 
leaping, or developing a four-footed gait, or some other dodge. The hypothet-
ical kangaroo is a monster. Some laws of nature, but not others, are carried 
over to establish the similarity we want between the actual and hypothetical 
worlds.

Generally, the way we calculate what similarity requires depends on the 
understood nature of the hypothesis. For example, consider the features that 
might hold in tailless kangaroo worlds listed in (28):

(28) Kangaroos have no tails, and
  1 Kangaroos’ tracks do not include a tail track.
  2 There is no kangaroo tail soup.
  3 Kangaroos have a genetic code different from the genetic code for 
     actual kangaroos.
  4 Kangaroos topple over.
  5 Kangaroos walk instead of leaping.
  6 Kangaroos have longer stronger forelegs than in actuality.

As we have already seen, to judge the truth of ‘If kangaroos had no tails 
they would topple over’ we include worlds with features 1–4, but we exclude 
worlds with features 5–6, because the hypothesis implicitly assumes that 
kangaroos have not adapted to taillessness in either of these ways. But for ‘If 
kangaroos had no tails there would be no kangaroo tail soup’ or ‘If kanga-
roos had no tails they would have a genetic code different from the actual 
code’ the selected worlds could include all the features 1–6. On the other 
hand, ‘If kangaroos had no tails they would walk instead of leaping’ expresses 
a hypothesis about adaptive evolution, so to evaluate this conditional we 
would use worlds with features 1, 2, 3, 5 and maybe 6, but we would exclude 
worlds with feature 4 on the grounds that it doesn’t observe normal patterns 
of evolution.

These examples show that the worlds at issue can’t be chosen until we know 
the nature of the hypothesis, which generally requires consideration of both 
the antecedent and the consequent. The key issue in fixing the right kind of 
similarity for a particular counterfactual is the causal connection between the 
antecedent and consequent which is almost always understood in the way we 
use if-sentences, and particularly with counterfactuals. For example, tailless-
ness in kangaroos will cause the kangaroos to topple over only if the laws of 
dynamics which participate in causing kangaroo-toppling are also present, but 
the normal patterns of evolution which would compensate for taillessness are 
absent.
To sum up, the logical analysis outlined here shows that implication can after all be used to analyse counterfactual conditionals. In addition to the logical basis of the analysis, we have seen that pragmatic considerations also play an important part – we use commonsense considerations about what we think the speaker intended, to adjust our calculation of relevant similarity and to choose the most appropriate worlds to test the speaker’s hypothesis.

EXERCISES

Truth conditions for modal sentences

(1) ∗
Write the full truth conditions (using possible worlds) for the sentences below. If a sentence strikes you as ambiguous between different kinds of modality, write the definitions for the different readings. (See (10)–(16) and (27) in the chapter.)

   a. Necessarily, a bachelor is unmarried.
   b. A child could have invented the mousetrap.
   c. If wishes were horses beggars would ride.
   d. The lake is sure to freeze tonight
   e. Villagers’ goats may graze on the green.
   f. Right-turning traffic must give way.

Modal verbs

(2) ∗∗ (recommended for discussion)
There are two different kinds of meaning marked by would and could in the sentences below. One kind of interpretation is modal, signalling that a base version of the sentence is to be evaluated in a context specified in terms of possible worlds.

   (i) What is the other kind of interpretation, and which sentences have it?
   (ii) The truth conditions for two of the sentences can be written as shown in Section 5.3. Write these definitions.
   (iii) See if you can outline a truth condition for the other two sentences. (This has not been covered yet but it isn’t difficult to figure out. Hint: The whole sentence is true if a ‘non-would’ or ‘non-could’ version of the sentence is true in a specified context. What is that context?)

   a. If the weather had been better the truck would have arrived on time.
   b. We knew the truck would arrive on time.
   c. If she’d been taller she could have seen in the window.
   d. I remember Stan could bench 450 pounds.

Another modality?

(3) ∗∗ (recommended for discussion)
We have seen that necessity is analysed with ∀ ‘all’ and possibility with ∃ ‘at least one’. There is another kind of modal-like meaning with epistemic and deontic versions,
which also correlates with a quantifier expression (but not a logical quantifier), and a common use of a modal verb – *should*, as illustrated below.

(i) Identify the modality in each sentence.
(ii) Can you construct truth conditions for the sentences using quantification over possible worlds? (Use the English word to represent the quantifier – it isn’t ∀ or ∃).

a. The traffic is light and he left in good time, so Jones should be home by now.
b. His wife needs help with the children so Jones should be home by now.

**Counterfactuals**

(4) ** (recommended for discussion)
First, take a vote on whether you agree more with (a) or (b). Does the counterfactual analysis presented in this chapter support one side or the other? Can you decide what the counterfactual analysis would predict?

a. If squares were circles then cubes would be spheres.
b. If squares were circles then cubes would be cylinders.

(5) *** (recommended for discussion)
Assume that Cain killed Abel. Then both the sentences below are counterfactuals, but they don’t have the same meaning. (Example (a) is an *indicative counterfactual* and (b) is a *subjunctive counterfactual*.)

(i) There is one important difference between the two in what it means for a world to be ‘relevantly similar to the actual world’. Can you identify this difference? (HINT: What else is carried across from actuality into the worlds where the antecedent is true?)

(ii) Using your answer to (i), outline truth conditions for (a) and (b).

a. If Cain didn’t kill Abel then someone else did.
b. If Cain hadn’t killed Abel then someone else would have.

**FURTHER READING**

For modality and possible worlds, see Chapter 15 in Martin (1987) and Bach (1989). A more advanced introduction to modality is in McCawley (1993), Chapter 11. For more advanced discussions of conditionals, see Sanford (1989), McCawley (1993), Chapter 15, and Nute (1984), especially Sections 1–6. Kratzer (1991) is a review article on modality.
6.1 Quantification beyond first order logic

Quantificational determiners are words or expressions like those underlined in the examples in (1). (Note that numerals such as four are sometimes best analysed as determiners but can also be adjectives.)

(1) several post offices, at least three hostages, a few flakes of paint, most vineyards in this area, every star in the sky, four notebooks, ...

We have seen that first order logic analyses every, each and all as the universal quantifier ∀ and some and all as the existential quantifier ∃. However, not all natural language quantifiers can be analysed in first order logic.

As we saw in Chapter 2, quantified propositions in first order logic have a general format:

(2) All men are mortal.
A dog barked.

∀x (MAN(x) → MORTAL(x))
∃x (DOG(x) & BARK(x))
quantifier        NP predicate connective VP predicate

(The order of BARK(x) and DOG(x) can be reversed because conjunction isn’t fixed in order). The chief point here is that the NP predicate (that is, MAN or DOG) and the VP predicate form separate atomic propositions which must be joined by a connective to form a single proposition.

If we use the same general format for most there are four possibilities to choose from:

(3) Most dogs are domestic.
   a. Most x(DOG(x) & DOMESTIC(x))
   b. Most x(DOG(x) ∨ DOMESTIC(x))
c. Most $x (\text{DOG}(x) \rightarrow \text{DOMESTIC}(x))$
d. Most $x (\text{DOG}(x) \leftrightarrow \text{DOMESTIC}(x))$

Formula (3a) is interpreted according to the truth table for conjunction.

(4) \begin{array}{ccc}
\text{DOG}(x) & \text{DOMESTIC}(x) & \text{DOG}(x) \& \text{DOMESTIC}(x) \\
line 1 & T & T \\
line 2 & T & F \\
line 3 & F & T \\
line 4 & F & F \\
\end{array}

(3a) is true only if line 1 is true for most things $x$. That is, (3a) is true if and only if for most things $x$, \text{DOG}(x) is true and \text{DOMESTIC}(x) is true – in short, $x$ is a domestic dog. ‘Most things are domestic dogs’ is not the meaning of \textit{Most dogs are domestic}.

Formula (3b) is a disjunction:

(5) \begin{array}{ccc}
\text{DOG}(x) & \text{DOMESTIC}(x) & \text{DOG}(x) \lor \text{DOMESTIC}(x) \\
line 1 & T & T \\
line 2 & T & F \\
line 3 & F & T \\
line 4 & F & F \\
\end{array}

(3b) is true if for most things $x$, any of lines 1, 2 and 3 is true for $x$. So (3b) is true if and only if for most things $x$, $x$ is a domestic dog (line 1), or $x$ is a wild dog (line 2), or $x$ is a domestic non-dog (line 3). Suppose that half of all things in existence are wild dogs, a quarter of all things are domestic cattle, and there are no domestic dogs. Then (3b) is true, but \textit{Most dogs are domestic} is false.

(3c) is an implication.

(6) \begin{array}{ccc}
\text{DOG}(x) & \text{DOMESTIC}(x) & \text{DOG}(x) \rightarrow \text{DOMESTIC}(x) \\
line 1 & T & T \\
line 2 & T & F \\
line 3 & F & T \\
line 4 & F & F \\
\end{array}

According to lines 1, 3 and 4 of the truth table, (3c) is true if and only if for most things $x$, $x$ is a domestic dog (line 1) or $x$ is a domestic non-dog (line 3) or $x$ is a wild non-dog (line 4). Suppose that 85 per cent of all things are domestic cattle and the rest are wild dogs. Then (3c) is true by line 3, even though all the dogs are wild. Suppose there exist three dogs (all wild), and a large number of wild seagulls. Then (3c) is true by line 4, but again there are no domestic dogs at all, and \textit{Most dogs are domestic} is false.

The final possibility in (3d) is the biconditional.
(3d) is true if and only if for most things $x$, $x$ is a domestic dog (line 1) or $x$ is a wild non-dog (line 4). This formula is also true in the universe containing only three wild dogs and a lot of seagulls, where *Most dogs are domestic* is false.

In short, none of the possible formulae gives the right truth condition for ‘Most dogs are domestic’, and *most* cannot be analysed in the same way as the universal and existential quantifiers.

An alternative way of analysing quantifiers, including the existential and universal, is Generalized Quantifier (GQ) Theory. As we shall see, GQ Theory requires the use of variables over predicates or sets, and so is second-order. (Predicates and sets were discussed in Chapter 4, but the necessary background will be reviewed again here.)

### 6.2 Generalized Quantifier Theory

The central idea in Generalized Quantifier theory is that a **quantifier expresses a relation between sets**. For example, *All ravens are black* expresses the relation illustrated in (8): The set of ravens is completely included in the set of black things, or, the set of ravens is a subset of the set of black things.

(8) ![Set diagram](#)

All ravens are black

To define the quantifier determiners as generalized quantifiers we need the following ideas and symbols from set theory (A and B stand for sets).
The definitions of quantifier determiners take the general form **Det Fs are G** or **Det F is G**. The variables F and G stand for the sets defined by 1-place predicates. The set defined by a 1-place predicate is the set of all entities of which that predicate is true – for example, the predicate DOG defines the set of dogs. Variable F stands for the set denoted by the highest N′ (pronounced ‘N-bar’: this is the node which combines with the determiner) and variable G stands for the set denoted by VP, as illustrated in (9):

\[
(9) 
\begin{array}{c}
\text{NP} \\
\text{Det} \\
\text{every} \\
\text{N′} \\
\text{that Jones fed} \\
\text{N} \\
\text{dog}
\end{array} 
\begin{array}{c}
\text{VP} \\
\text{V} \\
\text{was} \\
\text{A} \\
\text{happy}
\end{array} 
\begin{array}{c}
\text{S} \\
\text{F} = \text{the set of dogs that Jones fed} \\
\text{G} = \text{the set of entities which are happy}
\end{array}
\]
**Definitions for Quantifiers: Group 1**

<table>
<thead>
<tr>
<th>All Fs are G</th>
<th>$F \subseteq G$</th>
</tr>
</thead>
<tbody>
<tr>
<td>'The set of Fs is a subset of the set of Gs.'</td>
<td></td>
</tr>
</tbody>
</table>

| Most Fs are G | $|F \cap G| > |F - G|$ |
|---------------|-----------------|
| 'The cardinality of the set of things which are both F and G is greater than the cardinality of the set of things which are F but not G.' |
| 'Things which are both F and G outnumber things which are F but not G.' |

| Few Fs are G | $|F - G| > |F \cap G|$ |
|--------------|-----------------|
| 'The cardinality of the set of things which are F but not G is greater than the cardinality of the set of things which are both F and G.' |
| 'Things which are F but not G outnumber things which are both F and G.' |

**Definitions for Quantifiers: Group 2**

| No F is G | $|F \cap G| = 0$ |
|-----------|-----------------|
| 'The cardinality of the set of things which are both F and G is zero.' |
| 'There are no things which are both F and G.' |

| An F is G | $|F \cap G| \geq 1$ |
|-----------|-----------------|
| 'The cardinality of the set of things which are both F and G is greater than or equal to 1.' |
| 'There is at least one thing which is both F and G.' |

| Some Fs are G | $|F \cap G| \geq 2$ |
|---------------|-----------------|
| 'The cardinality of the set of things which are both F and G is greater than or equal to 2.' |
| 'There are at least two things which are both F and G.' |

| Four Fs are G | $|F \cap G| = 4$ |
|---------------|-----------------|
| 'The cardinality of the set of things which are both F and G is 4.' |
| 'There are four things which are both F and G.' |

| Many Fs are G | $|F \cap G| = \text{many}$ |
|---------------|-----------------|
| 'The cardinality of the set of things which are both F and G is many (or large).’ |
| 'There are many things which are both F and G.’ |

| Several Fs are G | $|F \cap G| = \text{several}$ |
|------------------|-----------------|
| 'The cardinality of the set of things which are both F and G is several.’ |
| 'There are several things which are both F and G.’ |

| Few Fs are G | $|F \cap G| = \text{few}$ |
|--------------|-----------------|
| 'The cardinality of the set of things which are both F and G is few (or small).’ |
| 'There are several things which are both F and G.’ |

| A few Fs are G | $|F \cap G| = \text{a few}$ |
|----------------|-----------------|
| 'The cardinality of the set of things which are both F and G is a few (or small).’ |
| 'There are a few things which are both F and G.’ |
With these definitions, quantifiers are analysed as relations between sets, or in other words, as two-place predicates taking sets as arguments. *Few* and *many* appear in both Group 1 and Group 2. The differences between the groups are discussed in the next section, and *few* and *many* are discussed in Section 6.3.2.

### 6.3 Different types of quantifier determiner

#### 6.3.1 Group 1 and Group 2 determiners

Determiners in the first group express asymmetric relations, in that the order of the arguments is significant, and the sets have different roles in the relation, for example:

(10) ‘All Fs are G’ is not equivalent to ‘All Gs are F’.
    ‘F ⊆ G’ is not equivalent to ‘G ⊆ F’.
    ‘All(F, G)’ is not equivalent to ‘All(G, F)’.
    ‘All dogs bark’ is not equivalent to ‘All barkers are dogs’.

(11) ‘Most Fs are G’ is not equivalent to ‘Most Gs are F’.
    ‘|F ∩ G| > |F – G|’ is not equivalent to ‘|G ∩ F| > |G – F|’.
    ‘Most(F, G)’ is not equivalent to ‘Most(G, F)’.
    ‘Most leaves are green’ is not equivalent to ‘Most green things are leaves’.

Determiners in the second group give the cardinality of a set which is defined as the intersection of F and G, and because intersection is symmetric, the roles of the F set and the G set in the relation are not different in principle, for example:

(12) ‘No F is G’ is equivalent to ‘No G is F’.
    |F ∩ G| = |G ∩ F| = 0.
    ‘No rose is black’ is equivalent to ‘No black thing is a rose’.

(13) ‘An F is G’ is equivalent to ‘A G is F’.
    |F ∩ G| = |G ∩ F| ≥ 1.
    ‘A spy is present’ is equivalent to ‘Someone present is a spy’.

(14) ‘Some Fs are G’ is equivalent to ‘Some Gs are F’.
    |F ∩ G| = |G ∩ F| ≥ 2.
    ‘Some plants are meat eaters’ is equivalent to ‘Some meat eaters are plants’.

(15) ‘Four Fs are G’ is equivalent to ‘Four Gs are F’.
    |F ∩ G| = |G ∩ F| = 4.
    ‘Four clocks are in the hall’ is equivalent to ‘Four things in the hall are clocks’.
The differences reviewed above mainly arise out of the special status of the F predicate with Group 1 quantifiers: Group 1 quantifiers express a proportion of the F set, and are sometimes called proportional quantifiers.

You need to know (roughly) the size of the whole F set to know how many Fs count as all Fs, most Fs, or few Fs. For example, suppose that eight dogs were vaccinated for rabies. If there are thirty dogs altogether, it’s true that few dogs were vaccinated; if there are eleven dogs altogether, it’s true that most dogs were vaccinated; and if there are eight dogs altogether, it’s true that all dogs were vaccinated.

Determiners which form proportional quantifiers are called strong determiners. Noun phrases formed with strong determiners are commonly called strong noun phrases or strong NPs.

The quantifiers in the second group express a quantity which is not a proportion. For example, for the truth of ‘Several dogs were vaccinated’ or ‘Eight dogs were vaccinated’, it matters only how many vaccinated dogs there are, and the number of dogs in total is irrelevant. These quantifiers give the cardinality of the F and G intersection, and are called cardinal quantifiers. Determiners which form cardinal quantifiers are weak determiners. Noun phrases formed with weak determiners are weak noun phrases or weak NPs.

6.3.2 The ambiguity of few and many

Few and many are often considered to be ambiguous between strong and weak readings. On their weak readings few and many denote a small number and a large number, respectively.

The strong reading of few is rather like the reading of the partitive construction, so few fleas on the strong reading means much the same as few of the fleas. This reading expresses a proportion of the group of fleas, and to know how many few indicates, we need to know roughly how many fleas there are altogether. Suppose a new insecticide is being tested on flies, fleas and cockroaches. After the first trial exposure the survivors are tallied.

(16) No flies and few fleas survived.

Here few fleas has the strong reading, expressing a small proportion, substantially less than half of the set of fleas used in the test. Say the trial used 1000 fleas and 89 survived – then Few fleas survived is true. But if the trial used 160 fleas and 89 survived then Few fleas survived is false.

The weak reading of few does not express a proportion, as in (17).

(17) The house seemed clean and Lee found (very) few fleas.

This sentence just means that the number of fleas Lee found was small, and the fleas Lee found are not expressed as some proportion of a given set of fleas.

The strong/weak contrasts are less clear with many, and speakers differ more on whether or not many has a strong or proportional interpretation at all. For
those speakers who consider *many* to have a proportional reading, *many* is like a weaker version of *most*: *Many* denotes a proportion greater than half, and *most* a proportion which is substantially greater than half of the background set (see also Exercise 15 for the meaning of *most*). For example, consider a class of 300 students voting on assessment methods.

(18) Many students preferred assignments to tests.

For proportional-*many* speakers, this is true only if more than 150 students preferred assignments, while for some speakers (including the writer) 100 students is a sufficiently large number to count as many, even though it is only a third of the total number of students, and the sentence is true if 100 students preferred assignments.

These judgments are quite sensitive to the size of the background set. Suppose the class has 24 students and eight of them preferred assignments. In this instance I am far less confident that many students preferred assignments to tests, because eight is not a large number, even though it represents the same proportion of the total as 100 out of 300. With the class of 24 students as background, it is more likely that numbers which count as large will be the same as numbers which are greater than half, in which case cardinality and proportionality cannot be distinguished.

Suppose there are six students in the class and five prefer assignments. The assignment-preferrers are substantially more than half the class, and it is true that most students prefer assignments, but because five is an absolutely small number it seems that *Many students prefer assignments* is an inappropriate and somewhat misleading way to describe the situation. Because no large numbers at all are involved, *many* does not apply. In short, it may be that *many* is really cardinal in all uses and simply denotes a large number.

*Large* is a predicate which must be interpreted in relation to a comparison standard: that is, whether or not a thing counts as large depends on what kind of thing it is. A common example of this is that a small elephant is very much larger than a large butterfly. *Large* and *small* do not have absolute values. When we talk about small elephants and large butterflies we can set the scale for largeness or smallness in comparison with the typical sizes of elephants and butterflies, which will fall somewhat near the middle of a fixed range. There is a maximum size and a minimum size for elephants (although the cut-off points are fuzzy). An elephant counts as large if it is considerably larger than an average-sized or typical elephant, and small if it is considerably smaller than an average-sized or typical elephant.

The largeness of numbers cannot be judged so easily without a relevant context because there is no upper limit on numbers in general, and so no fixed range to determine the typical or average number. (Negative numbers are not used in everyday talk about quantities, so generally zero is the lower limit on the relevant range of numbers.) Which numbers count as large varies with the context. In the examples above the total class size provides a number (300, 24, 8) as a standard for comparison – the comparison standard sets the overall scale for judging numbers as large or not. With a comparison range like 1–300 the
numbers which count as large may begin at around 80 or 90, which is less than half the comparison upper limit. Against a range of 1–24 the numbers which count as large will generally be the numbers which are larger than the average, or midpoint, of the range: then many and most will be the same quantities. But if the whole scale is confined to small numbers then perhaps no number on the scale can count as many, even if numbers near the top of the scale can count as most. The uses of many which seem to be proportional are the uses where many picks out a large number of members of a known ‘medium-sized’ background set. The background set provides a scale for judging what is a large number, and numbers which count as large coincide with numbers greater than half the background set.

6.3.3 Few and a few

Cardinal few and a few both denote a small number, but they are not interchangeable. The difference between them reflects what kind of quantity is expected in the context. This is illustrated in (19):

(19)  a. Spring was late in coming, and few flowers were blooming.
     b. ?Spring was late in coming, and a few flowers were blooming.
     c. ?Winter was ending at last, and few flowers were blooming.
     d. Winter was ending at last, and a few flowers were blooming.

In (19a, b) the first clause Spring was late in coming suggests, or introduces an expectation that there may be no flowers in bloom, or that the number of flowers in bloom will be smaller than one might otherwise expect for the time of year. In other words, there are only a small number or at most a small number of flowers in bloom. With this ‘at most, only (possibly none)’ expectation, few is appropriate as in (19a) and a few is anomalous as in (19b).

In (19c, d), on the other hand, the clause Winter was ending at last introduces the expectation that flowers will be beginning to bloom. The small number of flowers in bloom is at least as many as one might have expected, or at least a small number. Here a few is appropriate as in (19d) and few is anomalous as in (19c).

The ‘only n flowers’ or ‘at most n flowers’ expectation with ‘Spring was late’ in contrast with ‘Winter was ending’ is also illustrated in (20):

(20)  a. Spring was late in coming, and only five tulips were blooming.
     b. ?Winter was ending at last, and only five tulips were blooming.

The appropriate combinations in (19) are reversed, however, if the clauses are joined with but, which signals a clash in expectation between the two parts of the statement.

(21)  a. ?Spring was late in coming, but few flowers were blooming.
     b. Spring was late in coming, but a few flowers were blooming.
c. Winter was ending at last, but few flowers were blooming.
d. Winter was ending at last, but a few flowers were blooming.

The meanings of few and a few are explored further in Exercise 9.

6.3.4 Some and several

Plural some and several are both cardinal determiners of vague plurality, not specified as either large or small. Some is defined here as the existential quantifier with singularity or plurality marked on the N’, as in (22).

\[(22) \text{Some dog is barking.} \quad |D \cap B| \geq 1 \quad \text{‘at least one’}\]

\[\text{Some dogs are barking.} \quad |D \cap B| \geq 2 \quad \text{‘at least two’}\]

Several seems to differ from some in requiring a slightly larger number than two as the lower limit. In particular, if two dogs are barking then Some dogs are barking is true but Several dogs are barking is false.

6.4 Restricted quantifier notation

We saw in Section 6.1 that none of the first order analyses for most, repeated in (23), was adequate.

\[(23) \text{Most dogs are domestic.} \]
\[a. \text{Most } x(\text{DOG}(x) \& \text{DOMESTIC}(x))\]
\[b. \text{Most } x(\text{DOG}(x) \lor \text{DOMESTIC}(x))\]
\[c. \text{Most } x(\text{DOG}(x) \rightarrow \text{DOMESTIC}(x))\]
\[d. \text{Most } x(\text{DOG}(x) \leftrightarrow \text{DOMESTIC}(x))\]

Generalized Quantifier Theory offers a satisfactory semantic analysis, but there is still a notational problem – how do we form a simple representation for statements like Most dogs are domestic?

Ideally, a notation should also reflect the fact that the determiner usually combines with an N’ predicate to form a noun phrase. That is, natural language quantification is generally in the format all conjurors or several motoring enthusiasts, where the rest of the noun phrase specifies what kind of thing can be a value for the variable, rather than the fully general forms everything, something, and nothing. Another way to look at this is to compare the variables in natural language quantification with restricted variables. Recall that different kinds of conventional restrictions can be shown in the form of variables: x, y, and z stand for entities; p, q, and r stand for propositions, more specifically w stands for worlds and as we shall see t stands for times and e stands for events. In short, the N’ part of a quantifier NP restricts the variable. Correspondingly, the kind of quantifier expressed by a noun phrase is a restricted quantifier, illustrated in (24). The restricted quantifier corresponds to the whole noun phrase.
(24) Most dogs are domestic  
\[
[\text{Most } x: \text{DOG}(x)] \text{ DOMESTIC}(x)
\]

\[\text{whole expression is restricted quantifier with variable } x \text{ ranging over dogs}\]

determiner  restriction

For consistency, all quantifier determiners (including all/every and all/some) are represented in the same way, for example:

(25) All men are mortal.  
\[
[\text{All } x: \text{MAN}(x)] \text{ MORTAL}(x)
\]

Three leaves fell.  
\[
[\text{Three } x: \text{LEAF}(x)] \text{ FALL}(x)
\]

John ate a peanut.  
\[
[\text{A } x: \text{PEANUT}(x)] \text{ EAT}(j, x)
\]

No is a negative determiner and is represented in the same way.

(26) No dogs barked.  
\[
[\text{No } x: \text{DOG}(x)] \text{ BARK}(x)
\]

Further examples are:

(27) a. Several cars crashed.  
\[
[\text{Several } x: \text{CAR}(x)] \text{ CRASH}(x)
\]

b. Mary read many books.  
\[
[\text{Many } x: \text{BOOK}(x)] \text{ READ}(m, x)
\]

c. Marcia liked most plays written by Osborne.  
\[
[\text{Most } x: \text{PLAY}(x) \& \text{WRITE}(o, x)] \text{ LIKE}(m, x)
\]

d. Few books John owned were expensive.  
\[
[\text{Few } x: \text{BOOK}(x) \& \text{OWN}(j, x)] \text{ EXPENSIVE}(x)
\]

e. Many books John didn’t own were expensive.  
\[
[\text{Many } x: \text{BOOK}(x) \& \sim\text{OWN}(j, x)] \text{ EXPENSIVE}(x)
\]

f. Many books John owned weren’t expensive.  
\[
[\text{Many } x: \text{BOOK}(x) \& \text{OWN}(j, x) \sim\text{EXPENSIVE}(x)
\]

Example (26) above shows that negation expressed in the determiner is not analysed as the negation operator. The sequence not many is probably best analysed as a complex determiner, as in (28).

(28) Not many books John owned were expensive.  
\[
[\text{Not many } x: \text{BOOK}(x) \& \text{OWN}(j, x)] \text{ EXPENSIVE}(x)
\]

If we take the form of noun phrases as a guide, then it looks as if the is a quantificational determiner like the others, as in (29):

(29) The dog Jones bathed was howling.  
\[
[\text{The } x: \text{DOG}(x) \& \text{BATH}(j, x)] \text{ HOWL}(x)
\]
We will adopt the notation for now – the semantics of the as a quantifier is discussed more fully in Section 6.8.

6.5 Scopal ambiguity

As we saw in Chapter 2, when there are two or more quantifiers in a sentence the sentence may be scopally ambiguous. Wide and narrow scope readings are represented by the order of quantifiers in a logical representation. For example, the ambiguous sentence Some man loves every woman can have the two readings represented in (30):

(30) Some man loves every woman.
   a. $\exists x (\text{MAN}(x) \land \forall y (\text{WOMAN}(y) \rightarrow \text{LOVE}(x, y)))$
      ‘There is a man such that he loves all women.’
   b. $\forall x (\text{WOMAN}(x) \rightarrow \exists y (\text{MAN}(y) \land \text{LOVE}(y, x)))$
      ‘For every woman there is at least one man who loves her.’

The same strategy of ordering quantifiers in a formula is used with restricted quantifier notation. The two readings for (30) are:

(31) a. $\text{[Some } x: \text{MAN}(x) \text{]} \ [\text{Every } y: \text{WOMAN}(y)] \ \text{LOVE}(x, y)$
   ‘There is a man such that he loves all women.’
   b. $\text{[Every } y: \text{WOMAN}(y) \text{]} \ [\text{Some } x: \text{MAN}(x)] \ \text{LOVE}(x, y)$
   ‘For every woman there is at least one man who loves her.’

It can be difficult to decide how the different formulae correlate with the different scopal readings, so it is useful to review a step-by-step unpacking procedure to check which formula has which reading. Take a new example:

(32) a. Every rose emits a distinctive perfume.
   b. $\text{[Every } x: \text{ROSE}(x)] \ [\text{A } y: \text{DISTINCTIVE PERFUME}(y)] \ \text{EMIT}(x, y)$
   c. $\text{[A } y: \text{DISTINCTIVE PERFUME}(y)] \ [\text{Every } x: \text{ROSE}(x)] \ \text{EMIT}(x, y)$

The main point is to read the formula strictly from left to right, piece by piece. Begin with (32b), and take the first element which is the quantifier $[\text{Every } x: \text{ROSE}(x)]$. One way to think about the meaning of the quantifier is that it is an instruction for applying the rest of the formula to values for $x$ – in this case, to all values for $x$ (see also the discussion of $\forall$ in Section 3.1). So take a handful of representative $x$-values ($x_1, x_2, x_3, ...$) and consider them one at a time. The rest of the formula is asserted of each one.

(33) $x_1 \ [\text{A } y: \text{DISTINCTIVE PERFUME}(y)] \ \text{EMIT}(x_1, y)$
   $x_1$ (a rose) emits a distinctive perfume.
x₂ [A y: DISTINCTIVE PERFUME(y)] EMIT(x₂, y)
  x₂ (a rose) emits a distinctive perfume.

x₃ [A y: DISTINCTIVE PERFUME(y)] EMIT(x₃, y)
  x₃ (a rose) emits a distinctive perfume.

As (33) shows, when the universal has wide scope it is possible to interpret the roses as all having different perfumes.

Now consider the other formula as in (32c) above, where the existential has wide scope:

(34) [A y: DISTINCTIVE PERFUME(y)] [Every x: ROSE(x)] EMIT(x, y)

Take the first quantifier first – this presents (at least) one y such that y is a distinctive perfume. The rest of the formula is true of y: that is, y is a distinctive perfume such that every rose emits it.

(35) y = a distinctive perfume [Every x: ROSE(x)] EMIT(x, y)
  x₁ emits y; x₂ emits y; x₃ emits y, ...

On this interpretation all the roses smell the same.

### 6.6 Proportional determiners and discourse familiarity

The proportionality of strong determiners affects the way strong NPs function in a discourse. We know that strong determiners express a proportion of a total set, given by the restriction predicate, and that whether a proportion counts as all, few or most depends on the size of the whole set.

In fully general statements the whole set is the set of all things there are of the kind described. In the examples in (36) the proportions picked out are all of the men there are, most of the people there are, and few of the cars there are:

(36) a. All men are mortal.
    b. Most people are protective of children.
    c. Few cars can exceed 180 m.p.h.

But the quantified statements we use day to day, as in (37), are usually far less general, and pick out a proportion of a smaller set:

(37) a. All men must report before taking leave.
    b. Most people voted for Continuance.
    c. Few cars are expected to finish the trial.

Compared to the first group, these sentences strike us as being taken out of context, because a context is needed to provide the information of which men, which people and which cars are the relevant background: for example, men
on a particular military base, people who voted in a particular referendum, and cars in a particular performance trial. The use of examples like (37) signals that the speaker or writer assumes, or presupposes, that the audience can identify the background set, either from general shared knowledge, or because the information has been given earlier in the discourse. If the background set is known to the audience by being previously mentioned in the discourse it has discourse familiarity.

But suppose that the background set hasn’t been mentioned previously and isn’t part of the audience’s shared knowledge. Then the background set must be provided by including the information in N’, as shown in the bracketed NPs below.

(38) a. [All enlisted men now serving on this base] must report before taking leave.
b. [Most people who voted in the October temperance referendum] voted for Continuance.
c. [Few cars now competing in the Sunfuels trial] are expected to finish the trial.

If the description in N’ contains enough information to identify a background set which was not already familiar, then the incompleteness effect we see in (37) disappears.

Cardinal quantifiers do not express a proportion and do not require a given background set. Accordingly, a weak NP can be used to introduce new entities into a discourse without seeming to be incomplete. The example used above for weak few, The house seemed clean and Lee found very few fleas makes the first mention of fleas in the discourse; very few fleas shows discourse novelty. In contrast, in No flies and few fleas survived, the example for strong few, the fleas mentioned are taken from the familiar set of fleas in the insecticide test.

Although weak NPs do not need to denote familiar individuals, they can pick out individuals from a previously mentioned group, as in (39):

(39) As I waited, a large school party entered the museum. Several children went to the Egyptian display and looked at the mummy.

Here the NP several children denotes children from the previously mentioned school party, but this effect is produced by mechanisms of discourse coherence, and not by the semantics of several, which is not proportional.

### 6.7 Strong and weak determiners and there BE sentences

#### 6.7.1 The definiteness effect

NPs were first classified as strong or weak by Milsark (1974, 1977), who pointed out that the NP position after there BE in sentences like There is a fly in my soup must be filled by a weak NP. Strong NPs in this position are anomalous. The strangeness of sentences like (40e, f) is commonly called a definiteness effect.
(40) a. There was a dog in the garden.
    b. There were several dogs in the garden.
    c. There were many dogs in the garden.
    d. There were four dogs in the garden.
    e. #There was every dog in the garden.
    f. #There were most guests in the garden.

The strong/weak classification of NPs includes referring NPs such as names, demonstratives and pronouns, which are strong.

(41) a. #There was Terry in the garden.
    b. #There was that dog in the garden.
    c. #There were they/them in the garden.

Studies of the there BE construction and similar constructions in other languages have come up with a range of explanations for the resistance to strong NPs, generally along the following lines: the there BE construction asserts the existence of the denotation of NP. The existence assertion clashes with the semantics of strong NPs, which presuppose the existence of the referent (for referential NPs) or presuppose the existence of a background set (for quantificational NPs).

Testing for the strong/weak distinction with there BE sentences can be confusing, as there seem to be at least four kinds of there BE sentences:

(i) Basic existential there BE
(ii) Presentational there BE, introducing a new entity or situation into the discourse.
(iii) Task there BE, in the frame there BE NP to VP.
(iv) List there BE.

These types are reviewed below – only the first two types are diagnostic for strong NPs.

### 6.7.2 Types of there BE sentence

The main diagnostic there BE sentences, and the easiest kind to recognize, are basic existential sentences like those in (42):

(42) a. There is a solution to this problem.
    b. There are no ghosts.
    c. There is no antidote to cyanide.
    d. There is a roman à clef about them but I forget the title.

These sentences simply assert the existence or non-existence of whatever the NP denotes. In these sentences the NP must be weak.

(43) As for spontaneous combustion...
    a. There are several books on the subject.
b. There are many books on the subject.
c. There are four books on the subject.
d. There are a few books on the subject.
e. There are few books on the subject.
f. There are some books on the subject.
g. #There are the books on the subject.
h. #There are all the books on the subject.
i. #There are most books on the subject.
j. #There is every book on the subject.

Existential *there BE* sentences are said without any stress on *there*, so that (43j), for example, sounds like ‘Th’z every book …’. This is not the same as *there indicating location*, which is pronounced with more stress, as in (44):

(44) Here is the reading list, and there are all the books on the subject. (pointing)

Locative *there* with *be* can combine with any kind of NP, including strong NPs as in (45):

(45) There are most of the team now, over by the gate.

Suppose that *BE* in the *there BE* construction is ‘existence’ *BE*, in keeping with the view that *there BE* has existential force. Then the analysis of (43i), for example, is along the lines of (46):

(46) There are most books on the subject.
\[|F \cap G| > |F - G|\]
where \(F = \text{the set of all } x \text{ such that } x \text{ is a book on the subject}\)
and \(G = \text{the set of all } x \text{ such that } x \text{ exists}\).

According to this definition the books on the subject which exist outnumber the books on the subject which don’t exist. The trouble is that *most* requires the background set of all books on the subject, and this includes the assumption that all such books exist (in whatever mode of existence the discourse sets up). Given that all members of the background set of books on the subject exist, what can it mean to assert that the greater part of this same set exists? Such an assertion is redundant, at best, and such sentences are accordingly anomalous.

**Presentational** *there BE* introduces a new entity into the discourse, or an entity and situation combined, as illustrated in (47):

(47) a. In the corner between the bus shelter and the school wall there were [a number of cigarette butts] and [a couple of muddy heel-prints].
b. There was [a small brown cat] sitting on top of the door.
c. They can’t sneak in without a warrant – there are [some tenants in the house].
d. There are [only three rooms] available.

e. There are [five residents] sick.

h. There's [someone] knocking on the back door.

g. There's [a weta] in your curry.

These sentences do not simply assert the existence of the entities described (cf. *There are four kinds of camelid*), but also give information about the state of affairs in which the entities are involved. This is particularly clear in (34d, e) where the availability of the rooms and the sickness of the residents are the main information conveyed. Sentences like these must have a weak NP. Examples with strong NPs are in (48):

(48)  a. #There were most fans screaming on the jetty.
     b. #There were most of the fans screaming on the jetty.
     c. #There was every customer demanding a refund.
     d. #There were all the children playing in the garden.

Unlike the basic existentials, presentational sentences like those in (47) have a near-paraphrase without the *there BE* construction, as in (49):

(49)  a. A number of cigarette butts and a couple of muddy heel prints were in the corner between the bus shelter and the school wall.
     b. A small brown cat was sitting on top of the door.
     c. Some tenants are in the house.
     d. Only three rooms are available.
     e. Five residents are sick.
     f. Someone is knocking on the back door.
     g. A weta is in your curry.

The other two kinds of *there BE* sentences allow strong NPs.

The **Task there BE construction** takes the form *there BE NP to VP*, as illustrated in (50). Task *there BE* takes strong and weak NPs.

(50)  a. There are most of the fruit trees still to prune and spray.
     b. There are Maria, Lee and Casey to notify.
     c. If they try to block the road they’ll find there’s us to contend with.
     d. The meeting could be delayed – there’s that to consider.

This construction presents a task or action which lies ahead of someone; someone has to prune and spray the fruit trees, notify Maria, Lee and Casey, and so on. Although (50c, d) with pronouns sound a little odd, they sound more natural than a pronoun in either existential *there BE* (51a, b) or presentational *there BE* (51c, d):

(51)  a. #There is she/her.
     b. #Forget Ayesha – there is no she/her.
     c. #There’s he/him needing a new muffler.
     d. #There are they/them still expecting a reply.
The Task *there BE* construction is like an impersonal variant of a construction with *HAVE*, which includes the information of whose task it is.

(52)  
- a. The apprentices have most of the fruit trees to prune and spray.  
- b. I have Maria, Lee and Casey to notify.  
- c. They’ll have us to contend with.  
- d. We have that to consider.

The last kind of *there BE* construction gives the list reading, so-called because List *there BE* typically introduces a series of NPs uttered with a characteristic ‘list-reading’ intonation. The listed NPs denote entities with a common property, which may be identified in a question. The list is the answer to the question, for example:

(53)  
- a. Who might have seen Lenny leaving the bar?  
  – Well there’s the barman of course, Miss Radlett and her friend, everyone who was waiting to use the phone,...  
- b. Who’s free to work on Saturday?  
  – There’s me for a start, Paula, Larry and Henry...is four enough?  
- c. What do you have under $100.00?  
  – There’s this one, this one, and that one over there. (pointing)  
  – There’s everything in this case here.  
  – There’s most of the Ragzic range – they’re very popular.

Like Task *there BE*, List *there BE* also takes strong NPs quite freely.

In summary, strong NPs clash with existential and presentational *there BE*, and these two constructions are good tests for NP strength, but it is important to avoid List and Task *there BE*. List and Task *there BE* both allow strong NPs.

### 6.8 Determiner the and definite descriptions

I said in Section 6.4 that we will treat a noun phrase with *the* as a generalized quantifier, so, for example, *the dog Jones bathed* is represented as [The x: DOG(x) & BATH(j, x)]. However, the many ways a singular definite description can be interpreted make this treatment less straightforward than it is for NPs with determiners like *every* or *several*. In this section we will review the evidence for analysing *the* as a generalized quantifier.

Traditionally, definite NPs pick out definite or particular objects that the hearer can identify. Definite NPs include names, possessive NPs such as *John’s jacket*, demonstrative NPs such as *that boulder* or *those tablets*, and referring pronouns. But generally, discussion of definite descriptions concentrates on NPs beginning with the definite article *the*, like the examples below:

(54)  
- singular  
  - the earth, the moon, the president of Venezuela, the director of Eraserhead, the pie Clive had for breakfast
Singular definite descriptions seem to bridge the divide between quantifier NPs and names. On the one hand, a description like the director of ‘Eraserhead’ is structured like a quantifier NP, consisting of a determiner and an N with descriptive content, parallel to some fans of Rosemary Clooney or every yacht in the marina. On the other hand, this NP picks out a particular individual, and seems to refer to him just as the name David Lynch refers to him. A number of issues concerning the meaning of the arise out of this apparent dual nature of singular descriptions.

Our starting point for discussion of the is the classic analysis of Bertrand Russell, reviewed in the next section.

6.8.1 Russell’s Theory of Descriptions

Russell held that the reference of ‘logically proper names’ (which we would translate with a logical constant) is simple and direct. The semantic value of a name is simply the object it refers to, and accordingly the proposition expressed by a sentence containing a name contains that object as a component: such propositions are therefore said to be object-dependent. For example, the proposition expressed by the sentence Mt Cook is high contains the mountain itself as a constituent. Consequently, a sentence containing a name which has no referent fails to express any proposition at all.

On this point, names and singular descriptions are different. The difference can be illustrated with the examples below:

(55)  a. Brogdasa is becoming larger.
    b. The volcano near Paris is becoming larger.

Assuming that the name Brogdasa doesn’t refer to anything, sentence (55a) doesn’t express a proposition. If it did, we should be able to tell what kind of state of affairs would constitute the truth condition for such a proposition. Depending on what Brogdasa is (if the name has a referent) the situation might be a living creature growing, a cyclone building, or a town spreading. In fact the meaninglessness of the empty name leaves us in the dark. In contrast, sentence (55b) is meaningful, despite the fact that there is no volcano near Paris, and it is clear what kind of state of affairs would hold if the sentence were true. There would be one volcano near Paris and that volcano would be becoming larger. Accordingly, Russell proposed that a sentence with a non-denoting definite description is meaningful – it does express a proposition, and the proposition is false.

Generally, as Russell observed, a correct use of a definite description to denote an individual has two requirements: there must be an individual accurately described by the description, and there must be only one. These two requirements, commonly called existential commitment (there is such a thing) and the uniqueness requirement (there is only one), are built into the meaning of the in Russell’s (1905) analysis, as shown below.
(56) The King of France is bald

\[ \exists x (\text{KING OF FRANCE}(x) \& \forall y (\text{KING OF FRANCE}(y) \rightarrow y = x) \& \text{BALD}(x)) \]

‘There is an x such that x is a King of France, and any y which is a King of France is the same object as x, and x is bald.’

a. ‘There is a King of France’ (existential commitment)
b. ‘There is no King of France other than x’ or ‘there is only one King of France’ (uniqueness requirement)
c. ‘he is bald’

Here, to assert *The King of France is bald* is to assert three conjoined propositions, shown in (56a–c) above. If any of these is false the whole proposition is false. Given that France is a republic, the description *the King of France* doesn’t denote anything, and so *The King of France is bald* expresses a false proposition because clause (56a), the first conjunct, is false. (You may recall from Section 1.6 that Strawson criticized Russell’s analysis of *the King of France* on the grounds that the existence of the referent is presupposed, rather than asserted as part of the proposition. The presuppositional character of a definite description is consistent with the presuppositional character of strong quantifiers, as we shall see.)

The main enduring feature of Russell’s theory is that *the* is analysed as a quantifier (for Russell, the existential quantifier with the uniqueness qualification). If this is correct, a definite description should show the characteristics of quantifiers outlined previously in this chapter.

### 6.8.2 The as a generalized quantifier

Russell’s main focus was the different referential properties of names and singular definite descriptions. Concentrating on singular definite descriptions, Russell built the uniqueness requirement into the meaning of *the*. This implies that the definite article in plural descriptions must be analysed as a different word, because the meaning of a plural description such as *the books on that shelf* obviously is not compatible with the claim that there is only one such book. But surely the word *the* in *the book on that shelf* and *the books on that shelf* is the same word, and the analysis should separate out the uniqueness requirement so that it only applies to the singular NPs. Ideally, there is some constant meaning for *the* which is found in both singular and plural NPs. What kind of quantificational meaning might *the* have in plural NPs? Consider the underlined NPs below.

(57) Bob bought some livestock, sheep and cows, at the sale. Jenny vaccinated the cows the following week, and Bob dipped the sheep.

Here, Jenny vaccinated all of the cows that Bob bought, not just some of them, and Bob dipped all of the sheep he bought, not just some of them. So plural *the* seems to be a universal quantifier, meaning ‘all’.
The difference between singular and plural NPs is only marked on the noun, just as it is in NPs with *some*.

(58) Some dog ripped open the rubbish.  
     Some dogs ripped open the rubbish.

The number distinction with *some* was analysed like this:

(59) Some Fs are G  \(|F \cap G| \geq 2\)  
     ‘At least two things are both F and G’  
     Some F is G  \(|F \cap G| \geq 1\)  
     ‘At least one thing is both F and G’

Both of these definitions define *some* as giving the cardinality of the intersection of two sets. The extra information, ‘at least two’ or ‘at least one’, must come from the form of the noun.

The same strategy can apply to *the*. Assuming that *the* is a universal quantifier, the definition for it contains the definition clause for *all* and *every*.

(60) All Fs are G  \(F \subseteq G\)

Now add the information about number derived from the singular or plural form of the noun:

(61) The Fs are G  \(F \subseteq G \& |F| \geq 2\)  
     ‘All Fs are G and there are at least two Fs.’  
     The F is G  \(F \subseteq G \& |F| = 1\)  
     ‘All Fs are G and there is exactly one F.’

Existential commitment is coded in both the cardinality statements, ‘\(|F| \geq 2\)’ and ‘\(|F| = 1\)’, because both statements guarantee that at least one such thing exists. The uniqueness requirement is coded in ‘\(|F| = 1\)’, and only applies to singular descriptions, as required.

### 6.8.3 Definite descriptions as strong NPs

To analyse *the* as a universal quantifier determiner is to class definite descriptions with strong NPs, and we would expect to see the familiarity effects reviewed in Section 6.6 and the *there BE* effects reviewed in Section 6.7. This expectation is fulfilled – in fact, both these phenomena were first noticed with definite descriptions and have been traditionally identified as characteristic of definite descriptions. The realization that strong NPs in general share these effects came later.

**Familiarity effects**

In traditional grammars, before Russell’s logical analysis, the meaning of *the* was explained in terms of a contrast between the two articles, *the* and *an*, as illustrated below.
An old man came down the road leading a donkey. The donkey carried a load of produce for market, and now and then the old man adjusted the load more securely.

Here a signals a novel referent, used for the first mention of something, as in an old man and a donkey. The signals a familiar referent, so the donkey must refer to the donkey introduced by a donkey, and so on.

Earlier, this was not considered to be a quantificational phenomenon – the difference between the and a/an was described in terms of their use in the context of a discourse, and accordingly classed as pragmatic rather than semantic. More recently, a formal version of what is called the Familiarity Theory of Definiteness was developed by Irene Heim (1982), and a similar theory by Hans Kamp (1981).

In fact the quantificational analysis of the can be shown to predict the familiarity effect. Recall that strong quantifiers express a proportion of a set. To understand a proposition with a strong quantifier, the hearer must be able to identify the background set. For example, the quantifier in Most people voted for Continuance takes as a background set the set of people who voted in a particular referendum, and the hearer must know this to understand the proposition. Commonly, the relevant set is made known to the hearer by being previously mentioned in the discourse, in which case it has discourse familiarity.

According to the definition above, the NP the donkey in (62) expresses a universal quantification over a background set of donkeys with just one member. In identifying this set, the hearer also identifies the individual which is its only member. Because of the singularity component, a singular definite description provides not only a familiar set, but more saliently, a familiar individual, and in this regard singular definites are unlike other quantificational NPs. The familiarity of an individual is more striking than the familiarity of a background set, which is probably why the familiarity effect was first identified as a characteristic of the.

We saw in Section 6.6 that a strong quantifier NP does not need to take a familiar background set if the NP itself contains an adequate description of the background set. The repeated examples in (63) are incomplete descriptions:

(63) a. [All men] must report before taking leave.
b. [Most people] voted for Continuance.
c. [Few cars] are expected to finish the trial.

When the sentences stand alone, as they do here, they seem to be taken out of context – the NPs are incomplete in that they don’t give enough information for us to know which men, which people and which cars are mentioned. In an appropriate context these NPs would show a familiarity effect. The relevant groups of men, people and cars would count as familiar in being already known to the audience, commonly by being previously mentioned in the same text or discourse.
The examples in (64) contain more informative descriptions, where the background set of men, people or cars would not need to be familiar because it is identified in the NP.

(64) a. [All enlisted men now serving on this base] must report before taking leave.
   b. [Most people who voted in the October temperance referendum] voted for Continuance.
   c. [Few cars now competing in the Sunfuels trial] are expected to finish the trial.

Strictly speaking, the NPs in (64) are still incomplete, because we still need a context to identify, for example, the time now refers to, the base that this base refers to, and to identify exactly the October temperance referendum and the Sunfuels trial in question. So the sentences in (64) would still need to be used in a context which provides this information. To make the NPs in (64) complete, we would need to spell out all the information which depends on a context. For example, (64a) might be:

(65) [All enlisted men serving on the RNZAF base at Wigram on 24th December 1969] must report before taking leave.

The bracketed description in (65) is a complete description because it can be fully interpreted independently of any particular context of use. An incomplete description is a description which is partly dependent on a particular context, such as the bracketed NPs in (63) and (64). In such examples, the information required to complete the description is added by strengthening implicature (see Section 1.4).

The same kind of contrast is found with definite descriptions. Although incomplete descriptions are used more often in everyday talk, earlier discussions of definite descriptions focused on complete descriptions like those in (66):

(66) a. The author of Waverley
   b. The king of France in 1770
   c. The director of Eraserhead

These descriptions are complete because they pick out a unique individual in the actual world regardless of any particular context. There aren't any particular contexts which would provide alternative sets of authors of Waverley, or kings of France in 1770, or directors of Eraserhead. As things are, there is only one set of authors of Waverley with any members in it, and that is the set containing Sir Walter Scott as its only member. Similarly, the set containing Louis XV as its only member is the only non-empty set of kings of France in 1770, and the set containing David Lynch as its only member is the only non-empty set of directors of Eraserhead.
Descriptions like these (that is, complete singular definite descriptions) give the strongest support to Russell’s claim that singular definite descriptions have a uniqueness requirement, because these descriptions fit absolutely only one individual: in other words, there is absolutely only one thing of the kind described. When we turn to incomplete descriptions we see that the uniqueness requirement must work in tandem with information supplied from the context. An incomplete description does not fit absolutely only one individual – there may be many individuals the description fits. But in a particular context there may be only one such individual, and the uniqueness requirement is relative to that context. For example, the description the donkey fits thousands of individuals, assuming that there are thousands of donkeys in the world, but in the context provided by the narrative in (62) there is only one donkey. To interpret the donkey, we find the appropriate context with just one donkey in it – here, the context of the narrative. This amounts to fixing the background so that there is just one set of donkeys in the background, and that set has only one member.

So far the universal quantifier analysis of the predicts that plural definites have roughly the same meaning as NPs with all or every, except (possibly) for existential commitment. If this is so we would expect the universal quantifiers to be interchangeable, but in some contexts they are not.

(67) a. All men are mortal.
    b. Every man is mortal.
    c. ?The men are mortal.

It seems that (67c) is odd because plural the cannot be completely independent of a particular context, and must take some contextual subset. (67c) suggests that the men in some particular group, not men in general, are mortal. Even though the is interpreted as a kind of universal quantifier, unlike all and every, the is marked for use relativized to a context.

**Definite descriptions in there BE contexts**

The peculiar effect of strong NPs in there BE contexts was also first noticed with definite descriptions, and is traditionally called the *definiteness effect* for this reason. (Now that definiteness effects are known to hold for strong NPs generally, some writers apply the term *definite NP* to all strong NPs.)

(68) #There was the dog in the garden.
    #There is the antidote to cobra venom.

**Definite descriptions and scopal ambiguity**

*The* does not show all the quantifier characteristics as clearly as other quantifiers: in particular, it has been claimed that scopal ambiguities do not arise between the and another quantifier in the same sentence. This may not be quite
true, as the examples below indicate:

(69) Rex has been buying vintage cars in a remote country district, and was delighted with his purchases. Several cars had not left the garage in 30 years.
    \[\text{Several } x: \text{ CAR}(x)\] \[\text{The } y: \text{ GARAGE}(y)\] \(\sim\) \(\text{LEAVE}(x, y)\)

(70) When the car-hire firm was wound up, several cars had not left the garage in 30 years.
    \[\text{The } x: \text{ GARAGE}(x)\] \[\text{Several } y: \text{ CAR}(y)\] \(\sim\) \(\text{LEAVE}(y, x)\)

In (69), each car introduces a sub-domain in which there is a unique garage, and the quantifier is interpreted as picking out the unique garage for each car. In (70), the garage is interpreted from the context or the preceding discourse, and the sentence is interpreted as being about the car-hire firm’s large commercial garage. As the formulae show, the difference can be represented as a difference in scope of the two quantifier determiners, the and several, as well as the different extra information added by implicature.

The most important types of scopal ambiguity with the do not involve another quantifier, like the examples here. They involve interactions between definite descriptions and modal expressions or certain kinds of verbs, which fall under the rubric of referential opacity, addressed in Chapter 7.

### 6.9 Quantifiers and negative polarity items

**Negative Polarity Items** (NPIs or negpols for short) are expressions which can only occur in special contexts, including contexts which are in some sense in the scope of negation. Idiomatic NPIs include *budge an inch* and *lift a finger*, as illustrated in (71). The negative expression is underlined.

(71) a. Nobody lifted a finger to stop him.
    b. #Several people lifted a finger to stop him.
    c. I don’t suppose they’ll lift a finger to help.
    d. #I suppose they’ll lift a finger to help.
    e. He won’t budge an inch on this issue.
    f. #He might budge an inch on this issue.
    g. For all their efforts the trailer never budged an inch.
    h. #After all their efforts at last the trailer budged an inch.

The commonest NPIs are *any* (*anyone, anything*) and *ever*.

(72) a. Sue won’t ever go there again.
    b. Sue will ever go there again.
    c. The office hasn’t notified anyone.
    d. #The office has notified anyone.

Despite their name, NPIs are not actually confined to negative contexts, and occur with some quantifier determiners (in addition to *no*). As the examples in
(73) with NPI *ever* show, the NPI may appear in N’ (the (a) examples) or in VP (the (b) examples) or in both:

(73) *every*
   a. [Everyone who has ever been to Belltree Island] will want to go back.
   b. *[Everyone who has been to Belltree Island] will ever want to go back.

(74) *no*
   a. [No one who has ever been to Belltree Island] will want to go back.
   b. [No one who has been to Belltree Island] will ever want to go back.

(75) *few* (weak *few*)
   a. [Few people who have ever been to Belltree Island] will want to go back.
   b. [Few people who have been to Belltree Island] will ever want to go back.

(76) *some*
   a. *[Someone who has ever been to Belltree Island] will want to go back.
   b. *[Someone who has been to Belltree Island] will ever want to go back.

(77) *four*
   a. *[Four people who have ever been to Belltree Island] will want to go back.
   b. *[Four people who have been to Belltree Island] will ever want to go back.

These examples show that the NPI *ever* is licensed in N’ with *every*, *no* and *few*, but not with *some* or *four*, and is licensed in VP with *no* and *few*, but not with *every*, *some* or *four*. The results are summarized in (78):

(78) |          | ever in N’ | ever in VP |
    |----------|------------|------------|
    | *every*  | yes        | no         |
    | *no*     | yes        | yes        |
    | *few*    | yes        | yes        |
    | *some*   | no         | no         |
    | *four*   | no         | no         |

Ladusaw (1980) identified the contexts which license NPIs as *downward-entailing environments*. (When A entails B, if A is true then B must also be true – B is an entailment of A.) The entailing environments of interest in Ladusaw’s analysis are N’ and VP. In a sentence *Det Fs are G*, N’ denotes the F...
set and VP denotes the G set. Whether an N’ or VP is downward-entailing or upward-entailing depends on the determiner.

The N’ environment can be tested with the frames in (79):

(79)  a. If ‘Det Fs are G’ entails ‘Det Es are G’ and E ⊆ F, then F is **downward-entailing**. The entailment is towards the subset.
    b. If ‘Det Fs are G’ entails ‘Det Es are G’ and F ⊆ E, then F is **upward-entailing**. The entailment is towards the superset.

Given that the set of large dogs is a subset of the set of dogs, we can use the test sentences *Det dogs are white* and *Det large dogs are white*. Entailment from the *dogs* sentence to the *large dogs* sentence is entailment towards the subset, and is a downward entailment. Entailment from the *large dogs* sentence to the *dogs* sentence is an entailment towards the superset, and is an upward entailment.

The VP environment can be tested with the frames in (80):

(80)  a. If ‘Det Fs are G’ entails ‘Det Fs are H’ and H ⊆ G, then G is **downward-entailing**. The entailment is towards the subset.
    b. If ‘Det Fs are G’ entails ‘Det Fs are H’ and G ⊆ H, then G is **upward-entailing**. The entailment is towards the superset.

Given that the set of people whistling loudly is a subset of the set of people whistling, the VP test sentences can be *Det N is/are whistling* and *Det N is/are whistling loudly*. An entailment from the *whistling* sentence to the *whistling loudly* sentence is a downward entailment, and an entailment from the *whistling loudly* sentence to the *whistling* sentence is an upward entailment.

The tests for the different determiners are shown below. Note that *few* in (83) is weak *few*.

(81)  *Every* in N’: **DOWNWARD**

   a. Every dog is white entails Every large dog is white.
   b. Every large dog is white does not entail Every dog is white.

*Every* in VP: **UPWARD**

   c. Everyone is whistling does not entail Everyone is whistling loudly.
   d. Everyone is whistling loudly entails Everyone is whistling.

(82)  *No* in N’: **DOWNWARD**

   a. No dogs are white entails No large dogs are white.
   b. No large dogs are white does not entail No dogs are white.

*No* in VP: **DOWNWARD**

   c. No one is whistling entails No one is whistling loudly.
   d. No one is whistling loudly does not entail No one is whistling.

(83)  *Few* in N’: **DOWNWARD**

   a. Few dogs are white entails Few large dogs are white.
   b. Few large dogs are white does not entail Few dogs are white.
Few in VP: DOWNWARD

a. Few people are whistling does not entail Few people are whistling loudly.
b. Few people are whistling loudly does not entail Few people are whistling.

(84) Some in N’: UPWARD

a. Some dogs are white does not entail Some large dogs are white.
b. Some large dogs are white entails Some dogs are white.

Some in VP: UPWARD

a. Someone is whistling does not entail Someone is whistling loudly.
b. Someone is whistling loudly entails Someone is whistling.

(85) Four in N’: UPWARD

a. Four dogs are white does not entail Four large dogs are white.
b. Four large dogs are white entails Four dogs are white.

Four in VP: UPWARD

a. Four people are whistling does not entail Four people are whistling loudly.
b. Four people are whistling loudly entails Four people are whistling.

The downward and upward entailments are summarized in (86):

(86)

<table>
<thead>
<tr>
<th>Generalized quantifier</th>
<th>N’</th>
<th>VP</th>
</tr>
</thead>
<tbody>
<tr>
<td>every</td>
<td>down</td>
<td>up</td>
</tr>
<tr>
<td>no</td>
<td>down</td>
<td>down</td>
</tr>
<tr>
<td>few</td>
<td>down</td>
<td>down</td>
</tr>
<tr>
<td>some</td>
<td>up</td>
<td>up</td>
</tr>
<tr>
<td>four</td>
<td>up</td>
<td>up</td>
</tr>
</tbody>
</table>

The environments which allow negative polarity items were listed in (78), repeated here in (87). As we see, the NPI licensing environments are exactly the downward-entailing environments, as predicted.

(87)

<table>
<thead>
<tr>
<th>Generalized quantifier</th>
<th>ever in N’</th>
<th>ever in VP</th>
</tr>
</thead>
<tbody>
<tr>
<td>every</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>few</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>some</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>four</td>
<td>no</td>
<td>no</td>
</tr>
</tbody>
</table>

### 6.10 Generalized quantifiers as lambda functions

Given that a quantifier determiner expresses a relation between sets, it is a function that takes two predicates to form a proposition. The two arguments to the determiner are the predicate expressed by N’, which is of type <e, t>,
and the predicate expressed by VP which is also of type <e, t>. So a quantifier
determiner is of type <<e, t>, <<e, t>, t>>. The argument structure of a quanti-
fier in subject position is diagrammed in (88):

(88)

```
S
   /\
  /   \  \\
NP <<e, t>, t>  VP <<e, t>
   |     |
  Det <<e, t>, <<e, t>, t>>  N'
   |    |    \\     \\
   N'    VP  NP
```

To express the meanings of quantifiers in terms of relations between sets as
defined in Section 6.3.1, we want to represent the sets defined by the functions
which are the arguments to the determiner – that is, the set of all the things of
which the predicate is true. The general pattern for symbolizing the set defined
by a function of type <e, t> is in (89). An example derivation for every is given in
(90), with the λ-reductions in (91). Note that it isn’t necessary for the functions
to be represented with different variables – this is done here for extra clarity.

(89) \( \lambda x [P(x)] \) defines the set \{y: \( \lambda x [P(x)] (y) \}\)
    or simply \( \{x: P(x)\} \)

(90) *Every dog barked.*

```
NP <<e, t>, t>  VP <<e, t>
   |    |
  Det <<e, t>, <<e, t>, t>>  N'
   |    \\    \\
   N'    VP  NP
```

\( \lambda G[[x: DOG(x)] \subseteq [u: G(u)]] \)

\( \lambda y[BARK(y)] \)

\( \lambda G[[x: F(x)] \subseteq [u: G(u)]] \)

\( \lambda y[BARK(y)] \)

\( \lambda z[DOG(z)] \)

\( \lambda y[BARK(y)] \)

\( \lambda z[DOG(z)] \)
Strong Determiners

All Fs are G  \( F \subseteq G \)  ( = Every F is G)

\[ \lambda F[\lambda G[[x: F(x)] \subseteq [u: G(u)]]] \]

\[ = \lambda G[[x: \lambda z[DOG(z)](x) \subseteq [u: G(u)]]] \]

\[ = \lambda G[[x: DOG(x) \subseteq [u: G(u)]]] \]

\( \textit{every dog} \)

\[ = \lambda G[[x: DOG(x) \subseteq [u: G(u)]] (\lambda y[BARK(y)])] \]

\[ = \{x: DOG(x) \subseteq [u: \lambda y[BARK(y)](u)]\} \]

\[ = \{x: DOG(x) \subseteq [u: BARK(u)]\} \]

The functions for the determiners which were defined in Section 6.3.1 are listed below.

<table>
<thead>
<tr>
<th>Strong Determiners</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Fs are G</td>
</tr>
<tr>
<td>( F \subseteq G )</td>
</tr>
<tr>
<td>( \Rightarrow \lambda F[\lambda G[[x: F(x)] \subseteq [x: G(x)]]] )</td>
</tr>
<tr>
<td>Most Fs are G</td>
</tr>
<tr>
<td>(</td>
</tr>
<tr>
<td>( \Rightarrow \lambda F[\lambda G[[x: F(x)] \cap [x: G(x)] &gt;</td>
</tr>
<tr>
<td>Few Fs are G</td>
</tr>
<tr>
<td>(</td>
</tr>
<tr>
<td>( \Rightarrow \lambda F[\lambda G[[x: F(x)] \cap [x: G(x)] &gt;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Weak Determiners</th>
</tr>
</thead>
<tbody>
<tr>
<td>An F is G</td>
</tr>
<tr>
<td>(</td>
</tr>
<tr>
<td>( \Rightarrow \lambda F[\lambda G[[x: F(x)] \cap [x: G(x)] \geq 1]] )</td>
</tr>
<tr>
<td>Some Fs are G</td>
</tr>
<tr>
<td>(</td>
</tr>
<tr>
<td>( \Rightarrow \lambda F[\lambda G[[x: F(x)] \cap [x: G(x)] \geq 2]] )</td>
</tr>
<tr>
<td>A few Fs are G</td>
</tr>
<tr>
<td>(</td>
</tr>
<tr>
<td>( \Rightarrow \lambda F[\lambda G[[x: F(x)] \cap [x: G(x)] = \text{a few}]] )</td>
</tr>
<tr>
<td>Four Fs are G</td>
</tr>
<tr>
<td>(</td>
</tr>
<tr>
<td>( \Rightarrow \lambda F[\lambda G[[x: F(x)] \cap [x: G(x)] = 4]] )</td>
</tr>
<tr>
<td>Many Fs are G</td>
</tr>
<tr>
<td>(</td>
</tr>
<tr>
<td>( \Rightarrow \lambda F[\lambda G[[x: F(x)] \cap [x: G(x)] = \text{many}]] )</td>
</tr>
<tr>
<td>Several Fs are G</td>
</tr>
<tr>
<td>(</td>
</tr>
<tr>
<td>( \Rightarrow \lambda F[\lambda G[[x: F(x)] \cap [x: G(x)] = \text{several}]] )</td>
</tr>
<tr>
<td>No F is G</td>
</tr>
<tr>
<td>(</td>
</tr>
<tr>
<td>( \Rightarrow \lambda F[\lambda G[[x: F(x)] \cap [x: G(x)] = 0]] )</td>
</tr>
<tr>
<td>Few Fs are G</td>
</tr>
<tr>
<td>(</td>
</tr>
<tr>
<td>( \Rightarrow \lambda F[\lambda G[[x: F(x)] \cap [x: G(x)] = \text{few}]] )</td>
</tr>
</tbody>
</table>

With these definitions for quantifier determiners, derivations are straightforward where the single quantified NP is the subject of the sentence, as in the example (90). However, the analysis encounters a type mismatch when the quantified NP is an object, as shown in (92). Following the composition of every and dog, the denotation of the object NP is of type \(<e, t>, t>\): it requires
an argument of type \(<e, t>\) to form a proposition. But the verb is transitive (it has a direct object), and so is of type \(<e, <e, t>>\). Consequently, functional application cannot form the verb phrase denotation with the types and functions as given.

\[
(92) \quad \text{S}_t \quad \text{Jones fed every dog}
\]

\[
\begin{array}{c}
\text{NP}_e \\
\text{VP} \\
\text{N} \quad \text{NP}_e \\
\text{Jones} \quad \text{fed} \quad \text{Det}_e \quad \text{N}
\end{array}
\]

\[
\begin{array}{c}
\text{every} \\
\text{dog}
\end{array}
\]

There is ongoing debate on the best solution to the problem of quantifier objects. In transformational grammar the object NP is analysed as undergoing movement to a position higher in the tree, where it is interpreted. (The movement is not seen in surface word order, but takes place at the Logical Form (LF) level of syntax.) For our purposes, this syntactic movement can be compared to the formation of a relative clause – they have relevant syntactic and semantic similarities, illustrated in (93). Syntactic movement of the NP leaves an element called a \textit{trace} in the object position, which is interpreted as a variable of type \(e\). The trace is syntactically co-indexed (subscript \(i\)) with the phrase that was originally in the trace’s position. This co-indexation shows that the denotation of the moved phrase binds the variable which is the denotation of the trace: that is, \(\text{phrase}_i \ldots \text{trace}_i\) is translated as \(Qx \ldots x\).

\[
(93) \quad \text{relative clause} \\
\quad \text{(the dog)} \quad [[\text{NP} \quad \text{which}, \text{i}] \quad \text{Jones fed } \text{trace}_i \\
\quad \quad \quad \quad \quad \lambda x \quad \text{FEED}(j, x) \\
\quad \text{syntactic movement} \\
\text{compare quantifier raising:} \\
\quad [[\text{every dog}, \text{i}] \quad \text{Jones fed } \text{trace}_i \\
\quad \quad \quad \quad \quad \forall x \quad \text{FEED}(j, x) \\
\quad \text{syntactic movement}
\]
In Chapter 4 (see examples (31)–(33) and discussion) we interpreted the movement in a relative clause as the formation of a λ-function, and the moved element (which or that) correlates reasonably with λ itself. Suppose that the same general idea applies in quantifier raising. The quantifier NP has its own interpretation and so is not itself the λ-operator. Suppose for the sake of argument that there is an element which we can call L which is added to the syntactic structure as part of the operation of quantifier raising. This is illustrated in (94):

Now the interpretation of S₂ arises from the combination of L and Jones fed trace, and is required to be of type <e, t> to serve as an argument to the quantifier every dog. A rule specific to the example in (94) would be (95a), with an informal general rule-of-thumb in (95b):

(95) a. \|L(Jones fed trace)\| = \lambda x[FEED(j, x)]
    b. Object-Quantifier-Raising Lambda Fix (OQRLF):
       \|L((_S NP V trace))\| = \lambda x[P(x)] where \|trace\| = x

Now the type structure for Jones fed every dog is (96):
The full composition for *Jones fed every dog* is shown in (97):

(97)
From the Lexicon:

\[ \text{\textit{trace}} = x' \]
\[ \text{\textit{Jones}} = j \]
\[ \text{\textit{feed}} = \lambda y[\lambda x[\text{FEED}(x, y)]] \]
\[ \text{\textit{dog}} = \lambda w[\text{DOG}(w)] \]
\[ \text{\textit{every}} = \lambda F[\lambda G[\{u: F(u)\} \subseteq \{z: G(z)\}]] \]

Terminal Node Rule:

\[ \{\text{\textit{Det}}\} = \{\text{\textit{every}}\} = \lambda F[\lambda G[\{u: F(u)\} \subseteq \{z: G(z)\}]] \]
\[ \text{\textit{NP}_1} = \text{\textit{dog}} = \lambda x[\text{DOG}(x)] \]
\[ \text{\textit{NP}_2} = \text{\textit{Jones}} = j \]
\[ \text{\textit{VP}} = \lambda y[\lambda x[\text{FEED}(x, y)]] (x') = \lambda x[\text{FEED}(x, x')] \quad \text{functional application} \]
\[ \text{\textit{S}_3} = \lambda x[\text{FEED}(x, x')] (j) = \text{FEED}(j, x') \quad \text{functional application} \]
\[ \text{\textit{S}_2} = \lambda x'[\text{FEED}(j, x')] \quad \text{OQRLF} \]
\[ \text{\textit{NP}_3} = \lambda F[\lambda G[\{u: F(u)\} \subseteq \{z: G(z)\}]] (\lambda x[\text{DOG}(x)]) \quad \text{functional application} \]
\[ = \lambda G[\{u: \lambda x[\text{DOG}(x)](u)\} \subseteq \{z: G(z)\}] \]
\[ = \lambda G[\{u: \text{DOG}(u)\} \subseteq \{z: G(z)\}] \]
\[ \text{\textit{S}_1} = \lambda G[\{u: \text{DOG}(u)\} \subseteq \{z: G(z)\}] (\lambda x'[\text{FEED}(j, x')]) \quad \text{functional application} \]
\[ = \{u: \text{DOG}(u)\} \subseteq \{z: \lambda x'[\text{FEED}(j, x')] (z)\} \]
\[ = \{u: \text{DOG}(u)\} \subseteq \{z: \text{FEED}(j, z)\} \]

‘The set of dogs is a subset of the set of entities that Jones fed.’

There is an important point to note at this stage. The compositional analyses of sentences like \textit{Barry introduced Harry to Larry} in Chapter 4 built a truth condition of the same form as the logical representations we had already been using, in this case – INTRODUCE(b, h, l).

However, with the compositional analysis of quantifiers, the composed truth condition is stated directly in terms of the set relationship, and the restricted quantifier notation reviewed in Section 6.4 does not play a part. The compositional treatment of quantifiers and their scope is quite complex, and will not be further addressed in this book. For ease of exposition we will continue to use the convention of restricted quantifier notation unless otherwise specified.
EXERCISES

Restricted quantifier notation

(1) *
Using restricted quantifier notation, give the formulae for the sentences below.
Example: John photographed every model that Bill hired.
[Every x: MODEL(x) & HIRE(b, x)] PHOTOGRAPH(j, x)

a. Alicia passed every message to Ralph.
b. Jones was eating something spicy.
c. Five films that Jenny had chosen were prize-winners.
d. The UFO that abducted Carla was luxurious.

(2) **
Using restricted quantifier notation, give the formulae for the sentences below.

a. Anne has read most books on Psychoanalysis.
b. Few who knew him supported Baxter.
c. Some students who heard both concerts were interviewed by Holmes.
d. Morris showed Jane every fingerprint he dusted.
e. Marcia peeled and quartered three apples.
f. Most travellers entering or leaving Australia visit Sydney.
g. Ramón signs every sculpture he makes.
h. Marcia and Clive ate four apples each.
i. Jones restored and sold several valuable paintings.
j. Most bulbs will not grow if they are dry.

(3) ***
Using restricted quantifier notation, give the formulae for the sentences below.

a. The witch picked a leaf from every tree in the forest.
b. A few people from each town lost everything they owned.
c. Three dogs and several cats killed two or three rats each.
d. Every dog that chased a cat that chased Mickey got a bone.

Scopal ambiguity

(4) **
Using restricted quantifier notation, give the two representations for each sentence below and give a non-ambiguous paraphrase for each representation.

a. Everyone in this room speaks two languages.
b. Three investigators described a new technique.
c. John gave all his students a book on Derrida.

Quantifier definitions

All of the underlined sequences below can be analysed as generalized quantifiers. Give the set theoretic truth conditions for these sentences, using the symbols given in the chapter.
Example: ‘More than four ants are black’ is true if and only if $|A \cap B| > 4$

(5) *

a. The ten apples are bruised.
b. Neither artist is Bulgarian.
c. Just two of the ten arrows are broken.
d. Between five and ten airlines are bankrupt.
e. Both avenues are broad.
f. Fewer than five aubergines are baked.

(6) **
The discontinuous determiners in the next examples relate three sets, two in a complex $N'$ and one in the VP. Give the set theoretic truth conditions for the sentences.

a. More architects than bricklayers are cricketers.
b. Exactly as many afghans as brownies are cooked.
c. Fewer autobiographers than biographers are candid.

All and every

(7) ** (recommended for discussion)
The first order formula

$$\forall x(F(x) \rightarrow G(x))$$

analyses universal quantification in terms of individual propositions: if $a, b, c, d,...$ are names of individuals, the propositions below, formed by substituting a name for $x$, are true if the universal proposition is true.

$$F(a) \rightarrow G(a)$$
$$F(b) \rightarrow G(b)$$
$$F(c) \rightarrow G(c)$$
$$F(d) \rightarrow G(d)$$

The set theory definitions for all and every are also based on individuals, given that the sets used are sets of individuals, that is:

$$\text{All Fs are G} \quad F \subseteq G$$
where $F =$ the set of all $x$ such that $F(x)$
and $G =$ the set of all $x$ such that $G(x)$

Now consider the sentences below. It seems that all and every are not interchangeable. What is the difference between them, and how does the difference bear on the analysis of universal quantification with $\forall x$?

a. All ravens are black.
b. Every raven is black.
c. *All raven is black.
d. *Every ravens are black.
e. All these pieces fit together to make a picture.
f. *Every piece here fits together to make a picture.

g. The price of all these pieces is $20.00.
h. The price of every piece here is $20.00. (See also Exercise 9.)

**Negative polarity items**

(8) *** (recommended for discussion)
Section 6.9 outlines Ladusaw's proposal that negative polarity items (NPIs) are licensed in downward-entailing environments. The sentences below illustrate the negative polarity phenomenon with contrasting verbs and NPI anyone. See if you can construct examples to apply the entailment tests for downward entailment, and check if Ladusaw's theory is supported by these data.

a. I doubt that Mary saw anyone.
b. I doubt that anyone saw Mary.
c. #I suspect that Mary saw anyone.
d. #I suspect that anyone saw Mary.
e. Mary forgot that she saw anyone.
f. Mary forgot that anyone saw her.
g. #Mary remembered that she saw anyone.
h. #Mary remembered that anyone saw her.
i. Mary denied that she saw anyone.
j. Mary denied that anyone saw her.
k. #Mary confirmed that she saw anyone.
l. #Mary confirmed that anyone saw her.

(9) *** (recommended for discussion)

(i) Use the tests in Section 6.9 to calculate the entailment patterns for a few, at most three, and at least three. Are the results consistent with the discussion of few and a few in Section 6.3.3?

(ii) Construct examples to test the NPI-licensing properties of weak few, a few, at most three and at least three. Are the results consistent with Ladusaw's account of negative polarity licensing?

**Group predicates**

**Preamble:** (new material)
There is a kind of ambiguity in the interpretation of NPs that is not scopal, illustrated here:

Two men lifted the mini.

On the first interpretation, there are two men such that each one lifted the mini. On the second interpretation, a two-man team lifted the mini. On the second interpretation it wouldn't be true to say of each man that he lifted the mini – it was the group
that did the lifting. The first interpretation is the one represented by the formula we already have:

\[
\text{[Two } x: \text{ MAN}(x)\] [The } y: \text{ MINI}(y)\] LIFT(x, y)
\]

For the second interpretation we need a new representation – we need to specify a group or set of two men such that it lifted the mini. As we have seen, set symbols are capital letters, so we will use X, Y, and Z as variables for sets.

\[
\exists X: |X| = 2 \& \forall x(x \in X \rightarrow \text{MAN}(x))
\]

‘There is a set X such that the cardinality of X is 2 and every member of X is a man and...’

\[
\exists X: |X| = 2 \& \forall x(x \in X \rightarrow \text{MAN}(x)) \ [\text{The } y: \text{MINI}(y)\] LIFT(X, y)
\]

...X lifted the mini

(10) **

Following the example above, write the formulae for the sentences below.

a. [Three violinists] played a trio.

b. [A thousand trees] surrounded the castle.

c. Diana bound [thirty pages] together. (Use BIND-TOGETHER as a predicate)

(11) **

The representation of groups as arguments for predicates allows us to analyse the all/every difference in the examples below from Exercise 7. For convenience, analyse these and here as a predicate HERE. Construct the formula for each example.

a. The price of all these pieces is $20.00.

b. The price of every piece here is $20.00.

Now (recalling that plural the is a universal quantifier) analyse the likely readings for these examples.

c. The apples in the barrel weigh 6 oz.

d. The apples in the barrel weigh 100 pounds.

Sometimes the group reading is forced by the predicate, which cannot sensibly apply to an individual; for example:

Fans poured in the gate.

#A fan poured in the gate.

In Fans poured in the gate there is no determiner to specify the size of the group, so the set can be shown as plural and then further interpreted pragmatically. (Alternatively you could specify the cardinality of the set as ‘many’.) I have left the path phrase in the gate unanalysed.

Fans poured in the gate

\[
\exists X: |X| \geq 2 \& \forall x(x \in X \rightarrow \text{FAN}(x))\] POUR(X, in the gate)
Write the representations for the sentences below.
(Hints: Ask yourself if the predicate could apply to a singular argument, cf. *A fan poured in the gate*. If not, then the predicate takes a group argument. Note that a collection is like a forest – although it is composed of individuals it is itself an individual.)

a. Boxes filled the garage.
b. Boxes lay on the floor.
c. The collection was in large crates.
d. Wooden boxes held the collection.

Generalized quantifiers and lambda functions

Using Examples (90) and (97) in Section 6.10 as a guide, construct compositional analyses for the sentences below.

a. All ravens are black.
b. Seven ravens are happy.
c. Jones ate five pies.
d. Fred loves most parties.

Using Examples (90) and (97) in Section 6.10 as a guide, construct compositional analyses for the sentences below.

a. Every book that Marisa read was a thriller.
b. John photographed every model that Bill hired.
c. Most travellers entering Australia visit Sydney.
d. Ramón signs every sculpture he makes.
e. Alicia passed several messages to Ralph.
f. Five films that Jenny had chosen were prize-winners.
g. The UFO that abducted Carla was luxurious.
h. Morris showed Jane every fingerprint he dusted.
i. Few voters who knew him supported Baxter.

In Section 6.3.2 I suggested that for some speakers ‘many’ denotes a proportion greater than half, and *most* a proportion which is substantially greater than half the background set’. This view of *most* reflects the common intuition that *most* doesn’t just mean ‘more than half’: for example, 52 per cent isn’t most. On the other hand (this is not so often noted), *most* seems a bit feeble for 98–99 per cent. If pressed, speakers tend to identify the *most* zone as a vaguely-bounded area centred on 75 per cent, roughly in the shaded area in the diagram.
Question: Is it necessary for the semantics to state that most means ‘substantially more than half’ and ‘not almost all’? (See Section 1.4.)


On negative polarity items, see Section 8.4.1, pp. 281–6 in Larson and Segal (1996) and Ladusaw (1996).
One of the recurrent themes in formal semantics is the issue of scope, which affects the interpretation of negation, quantifiers, and connectives. In this chapter we review another phenomenon which is generally analysed in terms of scope: the scope of modality and the scope of so-called propositional attitude predicates. Propositional attitude predicates are usually verbs but can include other word types, such as adjectives. They are basically predicates of thought, such as think, believe, know, hope, be aware, and so on.

As the name of the chapter indicates, the problem was first defined in terms of reference, and mainly in association with singular definite descriptions. We have seen (Section 6.8) that singular definite descriptions seem to straddle the boundary between descriptive noun phrases (such as quantifiers) and names. On the one hand, a singular definite NP is formally like a quantifier (Det + descriptive N′), shows scopal interactions with other quantifiers, and like other strong quantifiers shows familiarity effects and definiteness effects. On the other hand, definite descriptions seem to be name-like in their common use to pick out particular individuals – for example, the description the director of 'Eraserhead' and the name David Lynch both seem to pick out, or refer to, the same individual in the same way. In Section 4.6 the referring use of the N was suggested to be of type e, containing e-forming the.

The name-like nature of singular definites was more prominent in earlier philosophical discussion, and they were commonly classed as singular terms, a singular term being a referential expression like a logical constant. Assuming that the N is a name-like expression led the philosopher Quine to identify the puzzle that he called referential opacity. I begin with an outline of the original problem, drawing on Quine’s (1956) discussion of the problem and on Kripke’s (1980) response.

### 7.1 Quine’s referential opacity

To understand Quine’s point, in addition to classing definite descriptions as referring expressions, we also need a couple of basic logical principles. The first is Leibniz’ Law, also known as the Indiscernibility of Identicals.
(1) **Leibniz’ Law** (the Indiscernibility of Identicals)

If A and B are identical, anything which is true of A is also true of B, and vice versa.

Remember that the word *identical* here means ‘having the same identity’, and does not mean ‘having the same appearance’ as it does when we speak of identical twins. So *A and B are identical* means that A and B are one and the same thing. In this use *Mohammed Ali and Cassius Clay are identical* means ‘Mohammed Ali and Cassius Clay are one and the same person’.

It appears to follow from Leibniz’ Law that if A = B, anything you can truly say about A can also be truly said about B: after all, whatever you say is said about exactly the same thing under another name. This assumption gives us an important rule of inference called the **Principle of Substitutivity**.

(2) **Principle of Substitutivity**

IF

(i) ‘a’ refers to a and ‘b’ refers to b, and

(ii) ‘a = b’ is a true identity statement, and

(iii) S1 is a statement containing the expression ‘a’, and

(iv) S2 is a statement identical to S1 EXCEPT that the expression ‘b’ appears instead of ‘a’,

THEN S1 and S2 have the same truth value.

According to this principle, two NPs which refer to the same thing can be substituted one for the other in a sentence without changing the truth value of the sentence, which seems reasonable. Take an example:

(3)

a. Mohammed Ali = Cassius Clay       true
b. Mohammed Ali was a boxer.          true
c. Cassius Clay was a boxer.           true

The two names refer to the same person, so the identity statement (3a) is true. (3b) is true. If we take (3b) and substitute one name for the other name which refers to the same person, the sentence which results from this is (3c). According to the Principle of Substitutivity (3c) must also be true, which is correct. In other words, given that (3a) is true, (3b) and (3c) must have the same truth value, whatever it is.

Example (3) involves the substitution of names. Recall that we are assuming for now that singular definite descriptions are also referring expressions, like names, so the same substitutivity should apply to them. (That is, if definite descriptions are referring expressions they can be values for ‘a’ and ‘b’ in the Principle of Substitutivity.) Take some further examples:

(4)

a. Earth = the third rock from the sun.   true
b. Earth is inhabited by humans.          true
c. The third rock from the sun is inhabited by humans. true
(5) a. the director of *Eraserhead* = the director of *Blue Velvet*.  true
b. The director of *Eraserhead* is tall. true
c. The director of *Blue Velvet* is tall. true

(6) a. John and Cleo have two children: a daughter, Marcia, and a son, Damien. true
b. Clive met *Marcia* in town. false
c. Clive met *Cleo’s daughter* in town. false
d. Clive met *John’s daughter* in town. false
e. Clive met the daughter of *John and Cleo* in town. false
f. Clive met *Damien’s sister* in town. false

In all of these examples, if two NPs refer to the same thing, you can substitute one for the other in a sentence preserving the truth value, whether true or false.

Quine identified two main kinds of contexts in which the Principle of Substitutivity apparently fails, and described these contexts as **opaque contexts**. Contexts where the Principle of Substitutivity works are **transparent contexts**.

The first kind of opaque context is a **modal context**, as shown in the examples below:

(7) a. Yuri Gagarin = the first man in space. true
b. Yuri Gagarin might not have been *the first man in space*. true
c. Yuri Gagarin might not have been *Yuri Gagarin*. false

Sentences (7b) and (7c) are modal contexts because of the modal expression *might*. According to the possible worlds analysis of modality in Chapter 5, (7b) says that there is at least one possible world or state of affairs in which Gagarin is not the first man in space, which is true. An alternative possible world which didn’t actually eventuate is the possible world in which the American astronaut Alan Shephard is the first man in space.

Sentence (7c) says that there is at least one possible world in which Yuri Gagarin is not Yuri Gagarin. This is not to say that Gagarin exists in that world under another name. The sentence says that Gagarin exists in that world but isn’t the same person as himself. That is, a man exists in another possible world who isn’t Gagarin – that is certainly so, but in that case the sentence isn’t about this man, because he isn’t Gagarin, and the sentence refers to Gagarin by name. Wherever you locate Gagarin in an alternative possible world, he IS Gagarin, and a sentence that says about him that he isn’t Gagarin is false. So (7c) is false, and the substitution of the underlined NPs in (7) produces a change in truth value.

An important point to note at this stage is that names, as pure referring expressions, are what Saul Kripke called **rigid designators**. A name designates exactly the same individual in all possible worlds where that individual occurs, rigidly or inflexibly. It is important to think of a name as a word-form paired with its referent, and not just as the word-form alone. That is, *Samuel, Maria, and Keira* are vocabulary items which are not logical names unless assigned to
a unique referent. When different people have ‘the same name’ such as Bettina, in logical terms the word-form Bettina is multiply ambiguous among a range of unique referential meanings.

Returning to our main theme, the example in (7) above was of modal possibility. Quine also discussed necessity contexts, as in (8). (For the purposes of the example remember that Pluto had not been downgraded to a dwarf planet in Quine’s day.)

(8)  
\[
\begin{align*}
\text{a. } \text{the number of planets} &= \text{nine.} & \text{true} \\
\text{b. Necessarily, } \text{nine} &\text{ is nine.} & \text{true} \\
\text{c. Necessarily, the number of planets is nine.} &\text{ false}
\end{align*}
\]

Sentence (8b) says that the number nine is the same number as nine in every possible world. It’s important here to remember that we must stick to the language used in the example, which is Earth Modern English. There are certainly possible worlds in which people use the word-form nine, pronounced and spelt as we pronounce and spell it, to refer to a different number. This is irrelevant to (8b), because (8b) is a sentence in our language about other worlds, not a sentence in some other possible language. So (8b) is true. Sentence (8c) says that the number of planets is nine in every possible world, which is clearly false. There are possible worlds in which the number of planets (in our solar system) is five, or twelve, or thirty.

To sum up, we see that modal sentences are opaque contexts, because substituting NPs which refer to the same thing (Yuri Gagarin and the first man in space, the number of planets and nine) can produce a change in truth value.

The second kind of opaque context is found with propositional attitude predicates such as know, believe, think and hope. Recall that in Section 2.3.2 we saw that propositions themselves can be arguments to predicates, in sentences like (9a) and (9b), represented as (9c) and (9d):

(9)  
\[
\begin{align*}
\text{a. John thinks [that Maria is Polish].} \\
\text{b. Bella hopes [that Carol will ring Matt].} \\
\text{c. THINK(j, POLISH(m))} \\
\text{d. HOPE(b, RING(c, m))}
\end{align*}
\]

In sentences like (9a, b) (called propositional attitude reports) the subject is said to hold a proposition in mind as a thought of a certain kind, such as a hope, belief or desire. The chief point for our purposes, which we will return to, is that the bracketed parts in (9a) and (9b) describe some sort of mental contents of John and Bella respectively, rather than describing some situation out in the world.

Now consider an example from Quine. Quine sets the scene as follows:

There is a certain man in a brown hat whom Ralph has glimpsed several times under questionable circumstances on which we need not enter here; suffice it to say that Ralph suspects he is a spy. Also there is a grey-haired man, vaguely known to Ralph as rather a pillar of the community, whom
Ralph is not aware of having seen except once at the beach. Now Ralph does not know it, but the men are one and the same.

(Quine 1956: 179)

Quine also tells us that Ralph knows the man seen at the beach by name, as Bernard J. Ortcutt. According to Ralph, the pillar of the community whom he once saw at the beach is no spy. Therefore:

\begin{align*}
\text{(10)} & \quad \text{a. Bernard J. Ortcutt = the man seen at the beach} \\
& \quad \text{= the man in the brown hat} \quad \text{true} \\
& \quad \text{b. Ralph believes [that Ortcutt is a spy].} \quad \text{false} \\
& \quad \text{c. Ralph believes [that the man in the brown hat is a spy].} \quad \text{true} \\
& \quad \text{d. Ralph believes [that the man seen at the beach is a spy].} \quad \text{false}
\end{align*}

Here we see that the embedded sentence after \textit{believes} is an opaque context, because the change in same-referring NPs can produce a change in truth value.

To sum up so far: If we assume that names and singular definite descriptions alike are referring expressions, we must also assume that the Principle of Substitutivity applies to singular definite descriptions as well as to names. In fact, Substitutivity apparently fails in a modal context (a sentence modified by \textit{might}, \textit{possibly}, \textit{necessarily}, etc.) or a propositional attitude context (after a verb like \textit{believe}, the expression which describes the content of a belief) and these contexts are called opaque contexts. Transparent contexts are all the others, where Substitutivity works as it should. The Examples (3)–(6) illustrate transparent contexts.

Now the Principle of Substitutivity, as a logical law, should have no exceptions.

As I stressed earlier, Quine’s original outline of the problem depended on assuming that singular definite descriptions are referring expressions, and therefore should be subject to the Principle of Substitutivity. Suppose we reject the name-like analysis of definite descriptions and treat them instead as quantifiers as we did in Section 6.8 – what effect would this have on the phenomenon of referential opacity?

In the next two sections we will compare descriptions, analysed as quantifiers, with names in the two kinds of special context. As we shall see, modal contexts are not really opaque, so long as we don’t try to substitute quantifiers. But propositional attitudes are more complicated.

### 7.2 Modality, descriptions and names

#### 7.2.1 Modality and names

First, to introduce the representations, take the sentence \textit{Mozart might not have died young}, with the analysis below:

\begin{align*}
\text{(11)} & \quad \text{a. Mozart might not have died young.} \\
& \quad \hat{o} \sim \text{DIE YOUNG(m)}
\end{align*}
Working from left to right, we read this formula as:

(12) $◊$

There is at least one possible world $w$ such that...

$\sim$DIE YOUNG($m$)

‘Mozart did not die young’ is true in $w$

Note that the rest of the proposition after ‘$◊$’ is interpreted as describing a state of affairs in another possible world, not in the actual world. In particular, the name Mozart is interpreted within the scope of the modal operator.

(13)

$◊$

This bit happened in another possible world

DIE YOUNG($m$)

The whole sentence is true: there is at least one possible world in which Mozart lived to a seasoned maturity.

Can substitution of names in a modal context produce a change in truth value? In principle this is impossible, if we assume that names are rigid designators and refer to the same unique individual in all the possible worlds where that individual appears. Consider the examples in (14): so long as (14a) is true, then it is impossible for (14b) and (14c) to have different truth values. In any possible world where that person appears, both sentences say exactly the same thing about him.

(14)  

a. Mohammed Ali = Cassius Clay  
b. Mohammed Ali might not have won the world title.  
c. Cassius Clay might not have won the world title.

So according to Quine’s definition, modal contexts are not opaque where the substitution of same-referring names is concerned.

### 7.2.2 Modality and descriptions

Now consider definite descriptions – if we analyse them as quantifiers, does modality affect their interpretation?

(15) Yuri Gagarin might not have been [the first man in space].

To construct the representation for this proposition, first move the quantifier to the beginning and leave a variable in its place:

(16) [The $x$: FIRST MAN IN SPACE($x$)] Yuri Gagarin might not have been $x$
Now move the modal operator to the beginning:

(17) ◊ [The x: FIRST MAN IN SPACE(x)] Yuri Gagarin not have been x

The last step is to represent *Yuri Gagarin not have been x* using negation and identity:

(18) ◊ [The x: FIRST MAN IN SPACE(x)] ∼ g = x

Here the definite description is within the scope of modality. To read off the formula, start at the beginning:

(19) ◊

There is at least one possible world w such that...
[The x: FIRST MAN IN SPACE(x)]
There is exactly one thing (in w) which is the first man in space, and x refers to him... (Suppose we have chosen a world in which the Russians launched the first human into space, but the astronaut was a man called Popov. Then x refers to Popov.)

∼ g = x
Gagarin is not the same person as x (in w)
True: Gagarin is not Popov

So far so good: this gives the more salient reading for *Yuri Gagarin might not have been the first man in space*, which could be paraphrased as ‘Some astronaut other than Gagarin might have been launched into space first’.

But in principle there is also another much less plausible reading. Indeed, given that there are two scopal expressions (not counting negation) in the sentence, we would expect it to be scopally ambiguous, having another reading with the modal and quantifier in the opposite order, as in (20):

(20) [The x: FIRST MAN IN SPACE(x)] ◊ ∼ g = x

[The x: FIRST MAN IN SPACE(x)]

◊
∼

g = x
In this case the definite description is outside the scope of the modal and is interpreted in the actual world. Starting again at the beginning of the formula, we read as follows:

\[ (21) \text{[The } x: \text{FIRST MAN IN SPACE}(x) \text{]} \]

There is exactly one thing which is the first man in space, and \( x \) refers to him ... (In the actual world the first man in space is Gagarin, so \( x \) refers to Gagarin.)

\[ \diamond \]

There is at least one possible world \( w \) such that ...

\( \sim g = x \)

Gagarin is not the same person as \( x \) (in \( w \))

We have just established that \( x \) refers to Gagarin in this formula, so the formula is false, just as *Yuri Gagarin might not have been Yuri Gagarin* is false.

To sum up: The individual that is picked out by a description depends on where the description is interpreted. If the modal operator \( \diamond \) has scope over a description, then the description takes another possible world as background, and picks out an individual from that world (if any) according to the descriptive content. Accordingly, in a modal context a name and an actual-world-coreferring description may refer to, or pick out, different individuals, and so cannot be exchanged. In short, the opacity phenomenon depends on a description being in the scope of the modal operator.

\[ (22) \text{Yuri Gagarin might not have been the first man in space.} \]

opaque: \( \diamond [\text{The } x: \text{FIRST MAN IN SPACE}(x)] \sim g = x \)

transparent: \( [\text{The } x: \text{FIRST MAN IN SPACE}(x)] \diamond \sim g = x \)

### 7.3 Propositional attitudes and descriptions

In the previous section we saw that names and descriptions are not interchangeable in modal contexts because descriptions, unlike names, are affected by being in the scope of a modal operator. Descriptions with wide scope and descriptions with narrow scope can pick out different individuals, because they are interpreted against different possible worlds.

The scopal variation found with descriptions is also at play in propositional attitude contexts. To illustrate this we’ll use the examples from Quine.

\[ (23) \]

a. the man in the brown hat = the man seen at the beach \hspace{1em} true

b. Ralph believes [that the man in the brown hat is a spy]. \hspace{1em} true

c. Ralph believes [that the man seen at the beach is a spy]. \hspace{1em} false

Remember that Ralph knows he has seen Orttcutt, a respectable citizen, at the beach, but he does not know that Orttcutt is also the man in the brown hat. The judgments above, that (23b) is true and (23c) is false, are commonly supported
by reasoning that Ralph is the most reliable witness concerning his own beliefs. So if we were to present him with the bracketed sentences alone, and ask him to indicate agreement or disagreement, we would expect him to respond:

(24) a. The man in the brown hat is a spy.
    ‘Yes, so I believe.’
b. The man seen at the beach is a spy.
    ‘Good gracious! Certainly not!’

Now suppose that Ralph tells a friend about his observations of the man in the brown hat and his suspicions of espionage. Ralph’s friend knows that Ortcutt wears a brown hat to meet up with old college buddies to drink some liquor and shoot a little pool. Ralph’s friend knows that Ralph is talking about Ortcutt. To tease Ralph, his friend says to someone else ‘Have you heard the latest? Ralph here thinks old Ortcutt is a spy!’ Ralph protests bitterly, but when the facts are revealed he must admit that in a sense he did have the spy-belief about Ortcutt, without realizing it. That is, the person he had the spy-belief about is actually Ortcutt, also known to Ralph as the man seen at the beach. This reveals two different ways of reporting someone else’s belief about a person.

The first way is to describe the person in terms that the believer himself might use. In this case, the description or information used to identify the person is plausibly part of the believer’s thought. This is termed a de dicto belief, from the Latin meaning roughly ‘about the words’. The believer has a thought about a person or thing as described or identified in a particular way.

Given that a de dicto belief includes the description as part of its content, we can say that the description is in the scope of the belief predicate – the description has narrow scope.

de dicto – description has narrow scope

(25) Ralph believes that the man in the brown hat is a spy. true
    BELIEVE(r, \[The x: MAN IN THE BROWN HAT(x)\] SPY(x))

this bit is in Ralph’s head

(26) Ralph believes that the man seen at the beach is a spy. false
    BELIEVE(r, \[The x: MAN SEEN AT THE BEACH(x)\] SPY(x))

falsely reported to be in Ralph’s head: the way of identifying Ortcutt as the man seen at the beach is not combined with the spy-belief in Ralph’s thoughts.

The other way of reporting a belief is for the speaker to identify the person the thought is about in the speaker’s own terms, which may or may not be how
the believer would identify the person. The belief is reported as being held directly about the person or thing in question, and is called \textit{de re belief}, from the Latin ‘about the thing’.

Suppose Sally, a retired Olympic gymnast, and her friend Kay are watching a group of nine-year-olds practising at the local gym. One child is unusually talented, and Sally says about her:

\begin{enumerate}
\item[(27)] That kid could be a contender.
\end{enumerate}

Kay knows that the talented child lives next door to her sister-in-law Ann. That night Kay remarks to her husband

\begin{enumerate}
\item[(28)] Sally thinks the kid who lives next door to Ann could be a top gymnast.
\end{enumerate}

Kay reports what Sally said in words which make more sense to her husband, who would have no idea what she was talking about if she said ‘Sally thinks that kid could be a contender’. Sally would not immediately agree with the statement \textit{The kid who lives next door to Ann could be a top gymnast}, because that statement would not give Sally enough information to identify the child in question: the description \textit{the kid who lives next door to Ann} would not identify the child for Sally. Nevertheless, it is clear, that (28), what Kay said, is true. In (28) Kay reports Sally’s assessment as a \textit{de re} belief.

Given that the description is not part of the belief content in reporting a \textit{de re} belief, the quantifier takes wider scope than the belief predicate in the representation.

\textit{de re belief} – description has wide scope

\begin{enumerate}
\item[(29)] \[\text{[The } x : \text{KID WHO LIVES NEXT DOOR TO ANN}(x)\text{]} \text{THINK}(s, \Box \text{TOP GYMNAST}(x))\]
\end{enumerate}

The speaker, Kay in this case, uses the description to identify a particular child, because this description can be fully understood by her husband. Suppose the little girl is called Marama. Then \( x \) in the formula refers to Marama. Sally’s thought is reported as ‘\( x \) could be a top gymnast’ or ‘She could be a top gymnast’ where \( she \) refers to Marama. This is true.

Given that the difference between \textit{de re} and \textit{de dicto} interpretations of descriptions is a matter of their scope, we would expect to see scopal ambiguity in belief report sentences. We can see this with the examples about Ralph repeated below.
(30) Ralph believes that the man seen at the beach is a spy.
   a. \textit{de dicto}, false\n   \[\text{BELIEVE}(r, [\text{The } x: \text{MAN SEEN AT THE BEACH}(x)] \text{ SPY}(x))\]
   ‘Ralph believes he saw a spy at the beach.’
   
   b. \textit{de re}, true\n   \[\text{[The } x: \text{MAN SEEN AT THE BEACH}(x)] \text{ BELIEVE}(r, \text{SPY}(x))\]
   ‘You know the guy Ralph saw at the beach, Ortcutt – Ralph thinks he’s a spy.’

7.4 Summary: descriptions and scope

When we acknowledge that singular definite descriptions are not referring expressions but quantifiers, we see that the phenomenon of substitution is complicated by scopal ambiguity. Each of our test sentences presents two readings:

\begin{align*}
(31) & \Diamond [\text{The } x] \ldots x \ldots & \text{narrow scope, opaque} \\
& [\text{The } x] \Diamond \ldots x \ldots & \text{wide scope, transparent} \\
& \text{BELIEVE} (a, [\text{The } x] \ldots x \ldots) & \text{narrow scope, } \text{de dicto}, \text{ opaque} \\
& [\text{The } x] \text{ BELIEVE}(a, \ldots x \ldots) & \text{wide scope, } \text{de re}, \text{ transparent}
\end{align*}

This pattern clarifies where and why we find opacity effects. The interpretation of a description is affected by the context in which it is placed, including different possible worlds or an individual’s mental representation of a world. We see also that the truth value changes at issue violate no logical law, because the Principle of Substitutivity does not apply to descriptions: descriptions are not simple referring expressions.

Now if the Principle of Substitutivity does not apply to descriptions in any case, none of the data reviewed so far demonstrate the existence of opacity, so long as opacity is strictly defined in terms of the substitution of real referring expressions, such as names. Genuinely opaque contexts, if any, must involve the substitution of same-referring names. We have seen that same-referring names such as \textit{Mohammed Ali} and \textit{Cassius Clay} can be exchanged in a modal context without affecting the truth value, so modal contexts are not opaque. What about propositional attitudes?

7.5 Propositional attitudes and names

Ralph’s embarrassment in the Ortcutt affair (‘Ralph thinks old Ortcutt is a spy’) came about because he failed to recognize the man he saw in the brown hat as Ortcutt, whom he already knew from different circumstances. Consequently, he formed two different concepts of Ortcutt, each associated with a different complex of information drawn from his different encounters with Ortcutt.
Ralph thinks about Ortcutt in two ways, depending on which of these concepts is involved in his thought.

A de dicto report of Ralph’s thoughts about Ortcutt takes into account the particular way in which Ralph is thinking about Ortcutt at the time, and is expressed in terms that Ralph will recognize and agree with. What Ralph himself cannot do, or assent to, is to combine information from concept 1 with information from concept 2.

A de re report takes a wider view. Ralph’s thoughts connect with the world to the extent that the things and events he thinks about are real, not imaginary. Ralph’s error lies in separating his rather mistaken concept 1 from his more accurate concept 2, but nevertheless concept 1 is of a real person. When either concept 1 or concept 2 is activated, Ralph is thinking about the man Ortcutt, although only concept 2 is linked to his name. This ‘bottom line’ evaluation of Ralph’s thought is a de re evaluation.

We can’t test the substitution of same-referring names with Ralph’s two concepts, because only one of them has a name. But if we add different names to distinct concepts which actually represent the same person, we find that the substitution of same-referring names can change the truth value.

The Roman statesman Marcus Tullius Cicero is generally known to us these days as Cicero, but previously he was also commonly referred to as Tully, using an anglicization of Tullius. Lydia, a classics student, has prepared for an exam with an essay about Cicero in mind. As she leaves for the exam her elderly neighbour says to her:

(33) Classics today, Lyddie? Off to write about Tully then?

Lydia knows that Tully was a Roman politician around the first century BC – he was alive at the time Julius Caesar was assassinated. She doesn’t know he’s the same person as Cicero. She answers:

(34) I hope not! If the essay’s about Tully I’m sunk!

Fortunately, the essay question contains the magic word Cicero – Lydia writes a long essay about Tully without knowing it.
As Lydia is on her way to the exam, the statements below would seem to have the indicated truth values:

(35)  a. Lydia hopes there will be an essay question about Tully.  false
     b. Lydia hopes there will be an essay question about Cicero.  true

So it seems that, unlike modal environments, propositional attitude environments do not always allow the exchange of same-referring names with a constant truth value.

The judgments in (35) accord with the standard expectation that the thinker or hoper is the best witness on what exactly is thought or hoped. Lydia rejected Tully as a good essay topic, so (35a) is false. But on the other hand, surely it is also true to say that Lydia wrote the essay she hoped to write, and it was about Tully – she wrote about that man. So in another sense (35a) is true.

Lydia’s problem with Marcus Tullius Cicero can be seen as a matter of vocabulary, rather than a lack of knowledge about the man himself. Basically, she doesn’t know who the name Tully refers to – she doesn’t know what the word Tully means. Whether or not the thinker knows certain words can affect the apparent accuracy of propositional attitude reports even where no names are involved. Consider Liam, aged three. He can count one, two or three objects accurately, and he knows how to march ‘one, two, one, two’. He knows that people walk ‘one, two, one, two’ and so does a duck, but the cat doesn’t walk ‘one, two, one, two’ because ‘she got lotsa legs’.

(36)  a. Liam knows that a duck has two legs.
     b. Liam knows that a duck is two-legged.
     c. Liam knows that a duck is bipedal.

Although (36a) and (36b) are easily judged as true, (36c) can be judged as false. On the reading judged to be false, (36c) is understood to mean partly that Liam could apply the word bipedal to ducks, which seems unlikely: that would be comparable to a de dicto reading. But common sense indicates that Liam has a good concept of bipedality and applies that concept to ducks, so (47c) is true if understood in that way.

In these sorts of examples there is no question of reference and the issue is not confined to the Principle of Substitutivity. The general point is that a propositional attitude report may be intended and understood as reporting both (i) the thinker holds this proposition and (ii) the thinker could associate the concepts in his or her mental representation of the proposition with the words used in the statement.

These phenomena raise extremely difficult problems for semantic analysis, chiefly because the logical representations used for propositions do not seem to be appropriate for either kind of reported thought. If the reports are understood narrowly, so that the word which is chosen, such as Tully/Cicero or two-legged/bipedal is important, it seems that some stipulation about the required words should be added to the logical representation. For example, Lydia wants
what is represented in (37a) but not (37b):

\[(37)\]
\[\begin{align*}
\text{a. } & \quad [\exists x : \text{ESSAY}(x) & \& \text{ABOUT}(x, m)] \text{WRITE}(l, x) \\
& \quad \text{where } m = \text{Marcus Tullius Cicero and Cicero refers to } m \\
\text{b. } & \quad [\exists x : \text{ESSAY}(x) & \& \text{ABOUT}(x, m)] \text{WRITE}(l, x) \\
& \quad \text{where } m = \text{Marcus Tullius Cicero and Tully refers to } m
\end{align*}\]

Introducing words in this fashion is not a simple matter, particularly as we can truthfully report the thoughts of people who do not speak the same language. For example, (38a) is true, but Galileo would not have assented to (38b) because he spoke medieval Italian, and popular myth has it that what he said (when before the Inquisition) was (38c).

\[(38)\]
\[\begin{align*}
\text{a. } & \quad \text{Galileo insisted that the earth moves round the sun.} \\
\text{b. } & \quad \text{The earth moves round the sun.} \\
\text{c. } & \quad \text{Eppur, si muove!}
\end{align*}\]

Broad interpretations (including de re readings) are also puzzling. There’s a true reading of Lydia wants an essay question about Tully; a third party talking to Lydia’s elderly neighbour might truthfully describe Lydia’s hopes to him in these words. And as we saw earlier, there’s a true reading of what Ralph’s friend said to tease Ralph:

\[(39)\]
\[\begin{align*}
\text{a. } & \quad \text{Ralph thinks Ortcutt is a spy.} \\
\text{b. } & \quad \text{THINK}(r, \text{SPY}(o))
\end{align*}\]

The intuition that Ralph thinks Ortcutt is a spy is true (on the appropriate reading) rests on accepting Ralph’s actual thought as a version of SPY(o). That is, there is a proposition expressed by SPY(o) which Ralph has a propositional attitude towards, but SPY(o) isn’t exactly the content of Ralph’s thought. Rather, Ralph has a mental representation involving his Ortcutt-concept which is accurate or faulty according to the same circumstances in which SPY(o) is true or false, respectively. Ralph’s actual mental content and the proposition expressed by SPY(o) have some kind of parallelism, but the precise relationship between them is murky.

In summary, propositional attitude reports contain embedded sentences which denote mental contents. Our system of semantic representation, on the other hand, uses symbols which denote things and situations in reality and possible realities, not conceptual representations in a thinker’s mind. Plausibly, a reality-denoting representational system can represent the contents of a thought if the thought itself accurately represents reality. But the question of whether or not a thought does accurately represent external reality is a much-debated problem in epistemology (the philosophy of knowledge).

On the one hand, to the extent that we seem to successfully report the thoughts of others, we must assume that (i) humans generally share a basic conceptual representation system, in which for the most part they represent reality and possible realities in sufficiently similar ways, and (ii) the language
we speak in reporting the thoughts of others is translatable into the con-ceptual representational system (shared by the thinker). This also applies for false beliefs: for example, the sentence John believes that the earth is flat is true if in fact John does NOT represent reality to himself as it really is, but is interpre-t-able as intended only if the words the earth can be mapped to John’s mental representation of the earth, however inaccurate, and if the word flat can be mapped to John’s representation of flatness. That is, we assume that his erro-neous complex representation of a flat earth situation is made up of cognitive components we can speak of, because to some extent we all share them. In short, we might conclude that ‘non-idiosyncratic’ thoughts can be reasonably well analysed in a reality-based representational system.

But this kind of assumption is much less certain when we report the thoughts of thinkers unlike us, such as small children, whose developing cognitive structures are known to be different. If we say of a young child She thinks clouds are alive, what exactly are we reporting? It could be that the child hasn’t mastered the use of the word alive and applies it to all sorts of moving objects, generally to objects which are alive. It could be that the child thinks that clouds move under their own motive power and identifies that property as the property of being alive. Or it could be that she thinks clouds are animate.

A number of strategies have been proposed for analysing propositional attitude reports, but none is particularly successful. This book does not introduce any special notations for attitude reports, but remember that any expression which appears in the scope of a propositional attitude predicate may be interpreted in a way which is quite different from its denotational semantics. The details may differ from case to case.

7.6  De re and de dicto readings with other quantifiers

The de re/de dicto difference also appears with other quantifiers, as illustrated in (40) below:

(40) Giacomo believes several people in the room are counting cards.

On the de re reading, there are several people in the room about whom Giacomo believes ‘That person there is counting cards’. On the de dicto reading, Giacomo believes that there are several card-counters at work but does not attach his belief to any particular individuals. The scopal representations for the two readings are in (41). The room is left unanalysed for convenience.

(41)  de re  
a.  [Several x: PERSON(x) & IN(x, the room)] BELIEVE(g, COUNT CARDS(x))

    de dicto

b.  BELIEVE(g, [Several x: PERSON(x) & IN(x, the room)] COUNT CARDS(x))
However, the scopal analysis does not capture all instances of a possible ambiguity between what appear to be *de re* and *de dicto* interpretations. Consider (42):

(42) Gina wants to ask the whole class to her party.

The more salient interpretation of (42) is that Gina formulates her thought in terms of ‘the whole class’, and may not even know all the names of her classmates. But a distributive interpretation is also possible, on which Gina wants to individually invite a number of people who, taken together, happen to comprise her whole class. Note that our analysis so far does not show how to interpret the noun phrase *the whole class* as some kind of quantifier binding the individuals *x* who are in the class. A similar ambiguity arises with *Gina wants to invite half the class to her party*. A scopal analysis for these examples might involve recasting *the whole class* and *half the class* into sets composed of class-members (see Example 10(ii)).

### 7.7 Indefinite descriptions and specificity

As we have seen, Quine’s discussion of referential opacity mainly addressed the problem of variable reference in singular definite descriptions. Closely related phenomena with indefinite descriptions were separately identified and discussed under the rubric of *specificity and non-specificity*. Specificity and opacity overlap in that (non-)specificity includes scopal interactions between an indefinite NP and a modal operator or a propositional attitude predicate. Specificity phenomena also include scope interactions between an indefinite NP and negation or another quantifier.

Specificity and non-specificity in a propositional attitude context are illustrated in (43):

(43) **propositional attitude, specific**

  a. Mary wants to buy a Norton – she is negotiating with the owner.

**propositional attitude, non-specific**

  b. Mary wants to buy a Norton – she will look for one at the Biker Meet.

In (43a) *a Norton* is specific because it refers to a specific or particular bike which Mary wants to buy. In (43b) Mary has no particular bike in mind and here *a Norton* is non-specific. Another example of this ambiguity is *John wants to marry a Frenchwoman*, with the two readings ‘John wants to marry a particular woman who is French’ (specific) and ‘John wants to have a French wife’ (non-specific).

The specific/non-specific ambiguity in propositional attitude contexts is very like the *de re/de dicto* distinction applied to definites. A specific or *de re* reading appears where a reported thought is directed towards a particular individual
the speaker refers to. A non-specific reading appears where a reported thought is directed towards a class of objects or to any individual fitting the description contained in the NP, and no particular individual is referred to. This is like a *de dicto* reading, in which a reported thought is directed towards an individual as identified or described in a particular way.

As the comparison with opacity suggests, specific and non-specific readings are generally analysed as instances of scopal variation. The different readings in (43) can be represented as in (44):

(44) **propositional attitude, specific**

a. Mary wants to buy a Norton (she is negotiating with the owner.)

\[ [A \ x: \ \text{NORTON}(x)] \ \text{WANT}(m, \ \text{BUY}(m, x)) \]

**propositional attitude, non-specific**

b. Mary wants to buy a Norton (she will look for one at the Biker Meet.)

\[ \text{WANT}(m, [A \ x: \ \text{NORTON}(x)] \ \text{BUY}(m, x)) \]

Specific and non-specific ambiguities also appear in modal contexts, as illustrated in (45). Again, the ambiguities are analysed as instances of scopal variation.

(45) **modal context, specific**

a. John might have visited a friend – Amy Ho, do you know her?

\[ [A \ x: \ \text{FRIEND}(x, j)] \Diamond \ \text{VISIT}(j, x) \]

**modal context, non-specific**

b. John might have visited a friend – I really don’t know where he went.

\[ \Diamond [A \ x: \ \text{FRIEND}(x, j)] \ \text{VISIT}(j, x) \]

The specific reading of *a friend* in (45a) refers to a particular person, while the non-specific reading in (45b) does not refer to anyone in particular.

Indefinite NPs also show specificity contrasts in combination with negation. Again, these ambiguities are analysed as instances of variations in scope, as illustrated in (46):

(46) **specific**

a. George didn’t see a car coming round the bend – it nearly hit him.

\[ [A \ x: \ \text{CAR}(x)] \sim \ \text{SEE}(g, x) \]

**non-specific**

b. George didn’t see a car coming round the bend – but he wasn’t really watching the road, so he’s not sure whether any cars passed or not.

\[ \sim [A \ x: \ \text{CAR}(x)] \ \text{SEE}(g, x) \]
The terms specific and non-specific characterize the contrast in interpretation as the presence or absence of reference to a specific individual. Note that although there must be a particular individual referred to by a specific NP, a specific but indefinite NP (unlike a definite NP) does not signal to the hearer that he or she can identify the individual referred to.

The specificity contrast can also be described in terms of existential commitment. On the specific readings of a Norton, a friend or a car in the examples above, such an individual must exist in actuality. On the non-specific readings, a Norton figures in Mary’s thought, a friend figures in a hypothetical situation involving John, and a car figures in a non-realized situation involving George, but in fact there may be no such entity. Only the specific readings are committed to the existence of at least one Norton bike, friend of John or car on the road.

The fourth kind of specificity ambiguity arises with scopal interactions between an indefinite description and another quantifier. This kind of ambiguity involves only the question of whether or not a particular individual is referred to, and does not show variation in existential commitment.

(47) Every student prepared a paper by Quine.

specific
a. [A x: PAPER BY QUINE(x)] [Every y: STUDENT(y)]
   PREPARE(y, x)

non-specific
b. [Every y: STUDENT(y)] [A x: PAPER BY QUINE(x)]
   PREPARE(y, x)

On the specific reading of a paper by Quine there is a particular paper which every student prepared – for example, every student prepared for a seminar to discuss ‘On Mental Entities’. On the non-specific reading every student prepared a paper and all the prepared papers were by Quine, but they may have all been different papers. As before, the two readings are easily represented as scopal differences.

The term specificity is rather like the term definiteness, in that both terms in traditional grammar applied to rather vague referential properties of NPs. The analysis presented here, that specific NPs have wider scope than another scopal expression in the sentence, gives a plausible analysis for the traditional examples of specificity contrasts. In this analysis specificity is not a single unitary semantic property. With modality, propositional attitude verbs and negation, a specific interpretation (that is, the indefinite NP has wide scope) expresses particular reference and existential commitment. On the non-specific interpretation, where the indefinite NP has narrow scope, particular reference and existential commitment are both lacking. Scopal variation between an indefinite NP and another quantifier, on the other hand, only affects particular reference, and both the specific and non-specific readings entail the existence of what the indefinite NP denotes.
EXERCISES

Propositional attitude contexts

(1) *
The following sentence is scopally ambiguous. Give the formulae for both readings, and sketch a context in which the two readings differ in truth value.

Clive wants to read the book that June is reading.

(2) *
Ralph thinks that the man who lives upstairs from him is a spy. Ralph is a little paranoid – the flat upstairs is empty, and the noises Ralph hears on the stairs are merely a poltergeist. Does the sentence below encounter problems through the existential commitment of the? (See Section 6.8.1 for existential commitment.)

Ralph thinks that the man who lives upstairs is a spy.

(3) ** (recommended for discussion)
According to Quine’s analysis outlined in Section 7.1, which of the underlined NPs below is in an opaque context? (Sketch a context and show a substitution of NPs which does or does not preserve the truth value to support your case.)

Example:
Fact: The man Mary met in the bookshop is a notorious arms dealer. He manages to avoid being photographed so most people don’t know what he looks like.

(i) Mary danced with the notorious arms dealer the whole evening.
(ii) Mary danced with the man she met in the bookshop the whole evening.

It is impossible for (i) and (ii) to have different truth values. Even if Mary had no idea who the man was and would be appalled to hear it, it makes no difference to the fact that she danced with that man. The context Mary danced with _ the whole evening is transparent.

(i) Mary hoped the notorious arms dealer would ring her up.
(ii) Mary hoped the man she met in the bookshop would ring her up.

Here it is possible for (i) and (ii) to have different truth values on the de dicto interpretations. If Mary does not know that the man she met in the bookshop is the arms dealer, and hates the arms dealer on principle, then the de dicto reading of (i) is false (Mary thinks ‘I hope that cute arms dealer will ring me for a date’), even though (ii) is true (‘Lovely guy from the bookshop, ring me! ring me!’). The context Mary hoped _ would ring her up is opaque.

a. Marcia hopes that the winner of the competition will talk to her.
   b. My neighbour knows the Director of MI5 quite well.
   c. Clive says that the guy sitting over there is a millionaire.
d. Then Bob said ‘Your husband has had an accident’.
e. They needed a signature from Clive’s wife.
f. Obviously they needed a signature from Clive’s wife.
g. Clive told my brother to shove off.
h. The getaway car was driven by the former bank manager.

Propositional attitudes and scope signals

(4) *** (recommended for discussion)
Can you figure out what the problem is in the dialogue below?
What did the first man mean?
What did the second man suggest that the first man meant?
If the first man had meant what the second man implies he meant, what would he have said?
What is the scope signal?

First Man:  I thought your boat was longer than it is.
Second Man: No, my boat is not longer than it is.

Propositional attitudes and other (non-referring) substitutions

(5) ** (recommended for discussion)
Can you substitute the words bipedal and two-legged in the sentences below, preserving the truth value? Do (a) and (b) mean the same thing? (Can you describe possible circumstances in which one would be true and the other one false?)

a. Liam knows what bipedal means.
b. Liam knows that bipedal creatures are two-legged.

Modality and scope

(6) *
The following sentence is scopally ambiguous. Give the formulae for both readings and identify which reading goes with each formula.

Mount Everest might not have been the highest mountain in the world.

(7) **
There are three scopal expressions in the sentence below (two quantifiers and a modal). How many interpretations can you identify for the sentence? Write the representations for the interpretations you identify.

Everyone in the village might have been rich.

Specificity

(8) *
According to the scopal analysis of specificity in Section 7.6, each sentence below is scopally ambiguous. The underlined NP can be either specific or non-specific in
interpretation. Give both formulae for each sentence and indicate which reading goes with each formula.

a. Karen wants to shoot a lion.
b. Eric didn’t meet a reporter.
c. Clive might buy a painting.
d. Every flautist played a sonata.

The scopal analysis of specificity

Janet Dean Fodor pointed out the example below, which is at least five ways ambiguous. However, the scopal analysis of specificity can only show three of those readings.

John wants to have a coat like Bill’s.

(i) What are the five readings of the sentence? (Set the circumstances and fill the gap in John thinks to himself, ‘I want __.’)
(ii) Give the three formulae that the scopal analysis provides. Which readings do they express? (Suggestion: You can represent Bill’s coat as \[Qx: COAT(x) \& OWN(b, x)\].)
(iii) Why can’t the other two readings be represented in this system?

De dicto, de re, and scope

Section 7.5 identified an apparent de re/de dicto ambiguity which does not seem to be analysable as a straightforward scopal ambiguity:

Gina wants to invite the whole class to her party.

Part of the problem is that the whole class expresses a universal quantification over class members, but only indirectly. One way to spell out what the whole class means is to include reference to sets (see Examples 9–11 in Chapter 6). For example, the set of all Gina’s classmates can be analysed as:

\[\exists X: \forall x(x \in X \leftrightarrow (x \in Gina’s\ class \& x \neq g))\]

(i) Can you write representations for the interpretations below?
a. Gina thinks: ‘I want the whole class to come to my party’.
b. Gina thinks: ‘I want to invite Fred and Lucy and Ram and Rangi and Emma and Kyle and Dinah and Sasha and Zara and Bob to my party.’ (There are 11 in the class; these people and Gina.)
(ii) A similar ambiguity appears in the sentence below. Can you write representations for the two interpretations?

Gina wants to invite half the class to her party.
For a recent Russellian analysis of descriptions see Neale (1990), especially Chapters 1 and 4.

See dictionary and encyclopaedia entries for descriptions, reference, opacity, belief contexts, intensionality, propositional attitudes, sense and reference.

Berg (1988) discusses pragmatic effects on the substitution of NPs in belief contexts.

The discussion of opacity is based on Quine (1956) and Kripke (1980). Kripke (1980) is a classic discussion of a number of interrelated issues, including the reference of names and descriptions. The notion of names as rigid designators is presented in this monograph.

In a number of papers, Partee discusses the relationship between formal and psychological approaches to semantics, with particular reference to the problem of analysing belief-sentences. The ‘clouds are alive’ example in the preceding section is from ‘Semantics – Mathematics or Psychology?’ (1996). Also recommended is Partee’s ‘Belief-sentences and the limits of semantics’ (1982).

Johnson-Laird (1982) on the same problem covers a wide range of issues and is particularly recommended.
Intuitively, the kinds of events or situations that predicates describe can be seen to have certain broad distinctions in their forms, or shapes. For example, the kind of event described by the predicate *eat an apple* consists of an activity that moves forward until the apple is completely eaten, at which point the event is completed and cannot go on any further. In contrast, the kind of event described by *watch TV* doesn’t have any kind of natural forward movement or finishing point – it can go on and on. Distinctions like this form the basis for *aspectual event classes*, or *aktionsarten* (from the German *aktion* ‘action’ and *art* ‘sort or type’).

As we shall see in Chapter 9, this kind of predicate classification is only one of two main kinds of aspect, so I shall use the term *aktionsarten* (singular *aktionsart*) to focus on the classification of the base predicate at issue here. The other kind of aspect is marked by morphological forms of the verb. For example, the base predicate *read a novel* also has various forms with morphological aspect, including the perfective forms *has read a novel* and *had read a novel*, and the progressive forms *is reading a novel* and *was reading a novel*. (Tense and aspect forms of the English verb group are reviewed in Section 9.2.) The discussion here addresses the classification of predicates without morphological aspect.

The predicate-described situations under classification are called *eventualities* (from Bach 1981), which includes both states and events.

Four main classes of aktionsart are generally in current use, chiefly from the work of the philosophers Gilbert Ryle, Anthony Kenny and Zeno Vendler, particularly Vendler. Strictly, the classifications do not apply directly to eventualities themselves, but really apply to eventualities under a particular verb phrase description. An eventuality taken in itself may be described in different ways which place it in any of the four classes, depending on the verb phrase chosen to describe it or present it for attention. For simplicity we often refer to event classes and event characteristics, but strictly speaking these are classes and characteristics of eventualities under particular descriptions.
8.1 Vendler’s four aspectual classes

The classifications are characterized in terms of three main distinctions: telic vs. atelic, durative vs. non-durative and static vs. dynamic. I will outline these properties briefly here, and they will become clearer as we proceed.

The property of telicity (from Greek telos ‘goal, purpose, completion’) is the property of having a natural finishing point, like the example of *eat an apple* above. Any event which does not have a natural finishing point is atelic. Other telic predicates include *recite the limerick, drink a glass of beer, run to the corner*, and so on.

A durative event occupies time, in contrast with a non-durative event which is idealized to a point in time. Most events are durative; among the events which are conceptualized as non-durative are predicates like *notice the mark* which is idealized to a momentary transition between not being aware of the mark and being aware of the mark; another is *recognize the car*, idealized to a momentary transition between not knowing which car it is and knowing which car it is. Another way to think about non-durative events like these is that they comprise the ‘front edges’ of states. Predicates like *realize* and *notice* denote the front edge of states of awareness.

The difference between static and dynamic events is the difference between states and all the rest, which are collectively called events. State predicates include *know the answer, believe in UFOs, be hungry, be in the kitchen, contain toys*, and so on. States are internally uniform, one moment being much like another, and have no forward movement or natural beginning or end.

The four main *aktionsarten* are states, activities also called processes, accomplishments and achievements. Note that the classification applies to the predicate in its stem (uninflected) form.

States are further illustrated in the sentences below:

1. a. Brigitte is taller than Danny. *be taller*
b. The light is on. *be on*
c. Clive knows my brother. *know*
d. Coal and coke are different. *be different*
e. The cat is asleep. *be asleep*
f. Your umbrella is in the hall. *be in the hall*

States are atelic – they have no natural boundaries or *culminations* which constitute finishing points. States are durative – they occupy time, and can be said to last for minutes, weeks, years and centuries. States are static – nothing ‘happens’ in a state.

Processes or activities are illustrated in (2). Note that the arguments of the verb, as listed on the right, are part of the basic predicate, but adverbials are not.

2. a. John walked in the garden. *walk*
b. The leaves fluttered in the wind. *flutter*
c. Clive pushed a supermarket trolley. *push a supermarket trolley*
d. They chatted. chat
e. The guests swam in the river. swim
f. The visitors played cards. play cards

Processes are atelic and durative, like states, but unlike states, processes are dynamic. One way to see this is that processes generally have internal texture; for example, the fluttering of the leaves involves movement of the leaves, so that the leaves are in different positions at different moments during the fluttering event.

**Accomplishments** are the eventualities with the most complex structure, consisting of a process or activity with forward movement, leading up to a specified finishing point – that is, a telos or culmination. Accomplishments are illustrated in (3).

(3) a. John built a house. build a house
b. Marcia ate an apple. eat an apple
c. Jones ran a mile. run a mile
d. We did the dishes. do the dishes
e. The new mayor made a speech. make a speech
f. Raffaele painted a triptych. paint a triptych

Accomplishments are telic, durative and dynamic.

**Achievements** are illustrated in (4):

(4) a. Clive realized that Deirdre was gone. realize that p
b. They reached the summit. reach the summit
c. Jones spotted the car on the road. spot the car
d. Leo discovered a hoard of rare LPs in the attic. discover a hoard of rare LPs

As I said earlier, a canonical achievement is the onset of a state. In the examples in (4), realize expresses the onset of knowledge of a particular fact; reach expresses the onset of being at a location; spot expresses the first moment of seeing the car, and discover expresses the onset of knowing that the LPs are there. Achievements are classified as telic, but rather than having a telos, an achievement is a kind of telos. Upper and lower limits on periods of time can be classified as a *terminus a quo* (‘limit from which’) indicating the earliest possible time; or as a *terminus ad quem* (‘limit to which’), indicating the latest possible time. A telos is a kind of *terminus ad quem* and an achievement is a kind of *terminus a quo*.

Given that an achievement is an event boundary rather than a ‘full’ event, it is non-durative.

The properties of the four Vendlerian aktionsarten are summarized in (5):

(5) |   | Dynamism | Duration | Telos |
---|---|---|---|
State | − | + | − |
Achievement | + | − | + |
Activity/Process | + | + | − |
Accomplishment | + | + | + |
There is also a fifth type of aktionsart, the semelfactives, sometimes called point events or as Talmy (1985: 77) described them, full-cycle resettables, illustrated in (6):

(6) a. Jones rapped the table. \(\text{rap}\)
b. Jones blinked. \(\text{blink}\)
c. Jones coughed. \(\text{cough}\)
d. The light flashed. \(\text{flash}\)

A semelfactive is a brief event which 'resets', or returns to the initial situation, and so is inherently repeatable. A number of semelfactives describe physiological events (sneeze, cough, hiccup) which are often repeated. Semelfactive verbs of striking (rap, tap, kick, slap) describe events which are reset and ready to repeat in that the full action includes the withdrawal of the striking part back out of contact with the thing hit; for example, slap, kick, tap, pat. Blink and flash are also resettable – the eyes close and then open again, the light goes on and then off again.

Another characteristic of semelfactives (from Latin semel 'once') is that the described events are precisely countable, and this is often shown in paraphrases like those in (7) below:

(7) a. Jones tapped the pipe seven times.
b. Jones gave the pipe seven taps.
c. The light flashed three times.
d. The light gave three flashes.

Semelfactive predicates are difficult to classify according to the three main contrasts outlined above – I will return to this point in Section 8.4.

8.2 Diagnostic tests for aktionsarten

8.2.1 In adverbials

The most frequently used test for telicity is modification of the event duration by an adverbial of the form in ten minutes or for ten minutes, in a sentence in the simple past tense. Telic predicates take in adverbials; atelic predicates take for adverbials. The exact interpretation of the adverbial also shows differences among the aktionsarten. I begin here with in adverbials, and in the next section discuss a similar test, the take time construction, before turning to for adverbials in Section 8.2.3.

With an accomplishment an in adverbial expresses the duration of the event, as shown in (8):

(8) accomplishment
a. He can eat a meat pie in 60 seconds.
b. They built the barn in two days.
c. Jones walked to town in 45 minutes.
I point out here that the event duration interpretation of an *in* adverbial with an accomplishment predicate is possibly not a literal entailment, but arises by a kind of Informativeness implicature (see Section 1.4.2). If we indicate the size of an object by naming a container the object would fit into, the most informative choice is a container that provides a snug fit with no room to spare. For example, to indicate the size of a ball bearing, it would be true, but misleading, to say that it would fit in a teacup. So if an event is said to occur within an interval of one hour duration, we infer that the event occupied the whole hour. So to say, for example *They did it in an hour; in fact they did it in 45 minutes* is not contradictory but elaborative – the speaker goes on to give more detail.

Recall that the main difference between accomplishments and achievements is that achievements have no duration. It follows that an adverbial of duration cannot generally express the duration of the event itself with an achievement predicate. Instead, the *in* adverbial is interpreted as stating the time which elapses before the event, and the event occurs at the end of the stated interval. This is illustrated in (9). Sentences like (9b, c) may sound more natural with *within five minutes* or *within three days*.

(9)  
a. He recognized her in a minute or so.  
b. Jones noticed the marks on the wallpaper in five minutes at most.  
c. Jones lost his keys in three days.

An atelic predicate is usually anomalous with an *in* adverbial, as illustrated in (10) and (11). For some examples, a possible ‘repair’ reading is that the stated time elapsed before the event began. For example, (10a) might be interpreted as ‘After two years the couple began to be happy’. Even with this interpretation the sentence is usually awkward.

(10)  
\begin{enumerate}
  \item[\textbf{state}]  
  \begin{enumerate}
  \item The couple were happy in two years.
  \item The room was sunny in an hour.
  \item Jones knew him well in five years.
  \end{enumerate}
\end{enumerate}

(11)  
\begin{enumerate}
  \item[\textbf{process}]  
  \begin{enumerate}
  \item They walked in the park in half an hour.
  \item People waiting to buy tickets chatted in half an hour.
  \item Jones pushed a supermarket trolley in 90 seconds.
  \end{enumerate}
\end{enumerate}

It is essential with the *in* adverbial test to use simple past tense sentences, as *in* adverbials with future tense can modify any class of predicate, with the ‘delay before event begins’ reading. This is illustrated in (12)–(15). With the accomplishments in (14) the adverbial is ambiguous between expressing the actual duration of the event and the time to pass before the event begins.

(12)  
\begin{enumerate}
  \item[\textbf{state}]  
  \begin{enumerate}
  \item They will be happy in a year.
  \item The room will be sunny in an hour.
  \item Jones will know him in five years.
  \end{enumerate}
\end{enumerate}
(13) **process**
   a. We will walk in the park in an hour.
   b. They’ll chat in a few minutes.
   c. Jones will push the supermarket trolley in 90 seconds.

(14) **accomplishment**
   a. He’ll eat a meat pie in an hour.
   b. They’ll build the barn in two weeks.
   c. Jones will walk to town in 45 minutes.

(15) **achievement**
   a. He will recognize her in a minute.
   b. Jones will notice the marks on the wallpaper in a few minutes.
   c. Jones will lose his keys in three days.

It is also important to note that examples can be adjusted to contextualized interpretations which change the basic *aktionsart* of the predicate. Suppose Fred and Hortense take a walk every day along an unvarying route in the park. Then *They walked in the park in half an hour* might be understood to mean that they did their usual walk in half an hour. Coerced interpretations like these do not reflect the basic *aktionsart* of the predicate.

### 8.2.2 The take time construction

The *take* time construction illustrated in (16) below has a similar interpretation to *in* adverbials: it selects a telic predicate, expresses the duration of an accomplishment and the delay before an achievement.

(16) **accomplishment**
   a. It took 60 seconds for him to eat the pie.
   b. It took two days for them to build the barn.
   c. It took 45 minutes for Jones to walk to town.

(17) **achievement**
   a. It took a minute for him to recognize her.
   b. It took five minutes for Jones to notice the marks on the wallpaper.
   c. It took three days for Jones to lose his keys.

Although the temporal interpretation of *take* time is broadly the same as for *in* adverbials, on the event delay reading the *take* time construction has an added dimension of expectancy or effort as a prelude to the event itself. For example, (17a) suggests that during the minute, he was trying to remember who she was or an observer was waiting for him to recognize her; (17c) conveys that Jones was to be expected to lose his keys. Compare (17) with the simple temporal modifications in (18), where there is no such prelude effect.

(18) a. After a few minutes he recognized her.
    b. Five minutes later John noticed the marks on the wallpaper.
    c. After three days Jones lost his keys.
This prelude effect may indicate that the *take* time construction chiefly selects accomplishments. Where it is used to modify an achievement, the event is understood to have a quasi-accomplishment structure in that some kind of process leading up to the culmination is added.

With atelic predicates the *take* time construction may describe the interval to elapse before the onset of the state or process, as illustrated in (19). As with achievements, the sentences suggest trying or expecting during the interval denoted by the time expression. This is fairly natural in (19) but not in (20). Whether or not the difference holds generally between states and processes is not determined to my knowledge.

(19)  
\[
\text{state} \\
\begin{align*}
\text{a. It took two years for the couple to be happy.} \\
\text{b. It took an hour for the room to be sunny.} \\
\text{c. It took five years for Jones to know him well.}
\end{align*}
\]

(20)  
\[
\text{process} \\
\begin{align*}
\text{a. #It took half an hour for them to walk in the park.} \\
\text{b. #It took half an hour for people waiting to buy tickets to chat.} \\
\text{c. #It took 90 seconds for Jones to push a supermarket trolley.}
\end{align*}
\]

8.2.3 *For* adverbials

A *for* adverbial expresses the duration of an atelic event, as illustrated in (21)–(22):

(21)  
\[
\text{state} \\
\begin{align*}
\text{a. They were happy for forty years.} \\
\text{b. The room was sunny for most of the day.} \\
\text{c. Jones believed in UFOs for several years.}
\end{align*}
\]

(22)  
\[
\text{process} \\
\begin{align*}
\text{a. The cast rehearsed for three weeks.} \\
\text{b. They strolled about for several hours.} \\
\text{c. The choir sang for half an hour.}
\end{align*}
\]

A *for* adverbial is generally considered to be anomalous with a telic predicate, but for some younger speakers the clash between telic predicates and *for* adverbials seems to be weakening, and examples like (23a) and (23b) are acceptable.

(23)  
\[
\text{accomplishments} \\
\begin{align*}
\text{a. #He ate the meat pie for half an hour.} \\
\text{b. #They built the barn for two days.} \\
\text{c. #Harry swam the length of the pool for nine seconds.}
\end{align*}
\]

\[
\text{achievement} \\
\begin{align*}
\text{d. #They reached the summit for half an hour.}
\end{align*}
\]
With the *for* adverbial test it is important to focus on the event duration interpretation, as *for* adverbials can modify telic predicates on a different interpretation. If the predicate is telic, the *for* adverbial can express the duration of the state of affairs which is the result of the event – for short, the **result state**.

(24) a. Jones noticed the mark on the wallpaper for a day or so.
   (Jones was aware of the mark for a day or so.)

b. Ruby flew to Paris for a week.
   (Ruby intended to stay in Paris for a week.)

c. Beatrice put the wine in the fridge for an hour.
   (The wine was (or was intended to be) in the fridge for an hour)

Another complication with *for* adverbials is that a telic predicate modified by a *for* adverbial can be understood as a repeated series of events. A repeated series has no particular finishing point, and is atelic. A repeated series interpretation is usually available with an otherwise telic predicate if the event is easily repeatable, as in (25):

(25) a. Sally painted the view from her window for five years.

b. The gang painted the bridge for ten years.

If an event cannot be repeated with the same participants, the sentence must allow for an interpretation of a series of events with some change in the participants. A vague plural argument (*new clues* in (26b)) is one way for an event series interpretation to arise: Gina discovered different clues on different occasions. A mass noun (*crabgrass* in (26c) from Dowty (1979: 63)) also allows for a change in participants: the interpretation is that John discovered different crabgrass patches on different occasions.

(26) a. #Gina discovered the clue for months.
    b. Gina discovered new clues for months.
    c. John discovered crabgrass in his yard for six weeks.

### 8.2.4 The sub-interval property

In recent research a considerable consensus has developed on how to define telicity in terms of the sub-interval property. Strictly the sub-interval property concerns an analysis of telicity, rather than a diagnostic test. However, I include a discussion of this definition of telicity here because intuitions concerning the sub-interval property are generally clear-cut, and the definition can be used to check a classification. The discussion is also useful background for points concerning the progressive aspect in the following sections.

A telic event takes place at a particular interval of time. Consider the telic event described by *Jones ate a sandwich* as diagrammed in (27), with a beginning, middle, and end, progressing in time.
If we take the whole interval $I_a$ from the beginning of the event to the end, the event contained in that interval is accurately described by \textit{Jones ate a sandwich}. But suppose we take the sub-interval $I_b$: this interval also contains an event, but not the event \textit{Jones ate a sandwich} – this interval contains the eating process leading up to but not including the finishing point. This process is denoted by the progressive form \textit{Jones was eating a sandwich}. A \textit{Jones ate a sandwich} event has to include the finishing point.

Now compare atelic \textit{Jones watched TV} as diagrammed in (28). He started watching at a certain time and stopped at a certain time, as shown.

In this case, \textit{Jones watched TV} does accurately describe the contents of the sub-interval $I_b$, and the same applies to any number of sub-intervals of the event run time. The generalization is that \textbf{atelic events have the sub-interval property and telic events lack the sub-interval property}. In other words, the event described by a telic predicate occurs at a unique interval of time, whereas the event described by an atelic predicate is evenly spread through its run-time. (Remember that it is vital to test the appropriateness of the sentence in exactly the same form – that is, a proper part of \textit{Jones watched TV} is also \textit{Jones watched TV}, but a proper part of \textit{Jones ate a sandwich} is not \textit{Jones ate a sandwich}, but only the process denoted by the progressive \textit{Jones was eating a sandwich}).

### 8.2.5 Entailments of the progressive

There are two contrasts between telic and atelic predicates involving entailments from the progressive. Kenny (1963) pointed out the contrast in (29).

\begin{itemize}
  \item a. Jones is singing entails Jones has sung.
  \item b. Jones is building a shed does not entail Jones has built a shed.
\end{itemize}

A slightly different form of the same phenomenon is the so-called imperfective paradox, illustrated in (30):

\begin{itemize}
  \item a. Jones was singing entails Jones sang.
  \item b. Jones was building a shed does not entail Jones built a shed.
\end{itemize}
This difference between telic and atelic predicates follows from their differences in the sub-interval property reviewed in the previous section. The progressive form of an accomplishment only denotes part of the event, the process leading up to the finishing point. An assertion that this process has occurred cannot also entail that the event proceeded to completion, hence (30b). On the other hand, a process predicate has the sub-interval property, and the predicate (in its non-progressive form) applies to sub-parts of the event. \textit{Jones was singing} denotes an internal part of the singing event which is itself preceded by another singing sub-event, hence (30a).

### 8.2.6 Duration and the progressive

The class of achievements is not accepted as a distinct class by some scholars, who group achievements and accomplishments together. One of the main reasons to doubt that achievements and accomplishments are the same is the interaction of the progressive with achievement predicates. If the progressive converts a telic event to its component process stage, then it should be anomalous with achievement predicates because they have no process component and no duration. This prediction is borne out by canonical achievement predicates such as those in (31):

\begin{itemize}
  \item a. #Jones was recognizing the woman when she sneezed.
  \item b. #Jones was noticing the mark on the wall when the doorbell rang.
  \item c. #Jones was noticing the mark on the wall for a few microseconds.
  \item d. #Jones was losing his key when I spotted him.
  \item e. #Jones was turning fifty when the clock struck.
\end{itemize}

However, a number of much-discussed predicates which have been identified as achievement predicates easily take the progressive, as in (32):

\begin{itemize}
  \item a. Jones was winning for the first three laps.
  \item b. Jones was dying for months.
  \item c. They are reaching the summit now.
  \item d. Flight 34 is now arriving at Gate 19.
\end{itemize}

The predicates \textit{win (the race)}, \textit{die}, \textit{reach the summit} and \textit{arrive} have been classed as achievements because they are considered to describe instantaneous transitions, but unlike achievements such as \textit{notice}, \textit{realize} and \textit{recognize} they have clearly identified processes which normally lead up to them. To reach the summit one must approach it, to win the race one must lead the field at the final moment, to arrive one must approach the destination, and before dying one generally has a mortal illness or moribund episode. In other words, \textit{win}, \textit{die}, \textit{reach the summit} and \textit{arrive} describe the culminations of events which have the structure of accomplishments. In these cases, unlike the examples in (32), there is a process to serve as the interpretation of the progressive form. The difference between achievements and accomplishments is illustrated in (33). Example (33a) combines the progressive \textit{was dying} denoting the prelude process and the simple past tense \textit{died} denoting the actual event – these different
events occur in sequence. But in (33b), the process *was building that house* is part of the whole event denoted by the simple past *built it*, and the sequential interpretation of (33b) is anomalous.

(33)  
a. Jones was dying for months and finally died just before Christmas.

b. #Jones was building that house for months and finally built it just before Christmas.

### 8.3 Telicity and boundedness

Recall that a telic predicate expresses the natural finishing point of the event it describes. One of the main tests for the difference between telic and atelic predicates is their affinity for *in* and *for* adverbials: we could say an *in* adverbial expresses the ‘size’ of a telic event and a *for* adverbial measures the amount of an atelic event. These are illustrated in (34), with the predicates bracketed:

(34)  
a. Jones [sang madrigals] for two hours.

b. Jones [wrote the report] in an hour.

Now an interesting question arises about the larger sequence in (34a), *sang madrigals for two hours*. The whole expression does include a finishing point, which is whenever the two hours has elapsed. Is the longer expression then telic?

Some scholars have proposed unified accounts in which *sing madrigals for two hours* is classified as telic. However, others find the distinction between different types of bounding useful, and I shall adopt that approach here, reserving the term *telicity* for a natural finishing point expressed by the verb and its argument(s), if any. The arguments of a verb include path phrases, so a predicate like *run to the beach* is telic.

I shall use the term *boundedness* for the more general property of having an endpoint expressed by any means, contrasted with *unboundedness*. Telicity is a particular kind of boundedness. A predicate which is bounded but not telic is generally composed of an atelic predicate modified by an interval adverbial, as illustrated in (35), with the adverbials bracketed:

(35)  
a. The sun shone [all day].

b. He saw patients [between ten and three].

c. He will eat macaroons [until someone stops him].

### 8.4 Semelfactive predicates

Semelfactive predicates (*kick, pat, punch, flash*, etc.) are difficult to classify according to the usual tests, particularly in terms of telicity. Some scholars have suggested that semelfactives can be grouped with achievements as point events because of their typical brevity. However, unlike achievements, semelfactives
are not generally modifiable with *in* adverbials, as illustrated in (36). If an interpretation is forced, it tends to be that of the delay before the event occurs rather than the duration of the event – see (36a) where a moment is a plausible length for the event. Even so, the sentences are anomalous.

(36) **semelfactive**
  a. #Jones rapped the table in a moment.
  b. #Jones blinked in a minute.
  c. #Jones coughed in an hour.
  d. #The light flashed in ten minutes.

These examples contrast with the achievements in (37), where the *in* adverbial expresses the delay before the event occurred.

(37) a. The truck arrived in about an hour.
    b. They reached the summit in a day.
    c. He noticed the difference in a few seconds.

On the other hand, a *for* adverbial is always well-formed with a semelfactive predicate, but the predicate takes the interpretation of a repeated series of events, which is a kind of process, and atelic. As the series reading is also available for achievements and accomplishments with a *for* adverbial (see (25)–(26) above), the test doesn’t clarify the telicity or atelicity of semelfactives.

(38) a. Jones rapped the table for a minute.
    b. Jones blinked for a minute.
    c. Jones coughed for an hour.
    d. The light flashed for ten minutes.

A semelfactive predicate in the progressive also usually takes the repetition interpretation, so for example, *Jones was rapping the table* means that Jones was in the process of repeatedly tapping the table. (It is possible to construct a freeze frame scenario in which *Jones is rapping the table* describes the mid-point of a single rap on film.) Because the progressive converts the semelfactive to a process interpretation in any case, the entailments from the progressive are those typical of atelic predicates:

(39) a. Jones is rapping the table entails Jones has rapped the table.
    b. Jones was rapping the table entails Jones rapped the table.

One of the main differences between semelfactives and achievements is that a canonical semelfactive event produces no particular result – indeed, the ‘full-cycle resettable’ nature of semelfactives rests on the return at the end of the event to the initial state, ready to repeat. In contrast, a canonical achievement is the onset of a state that did not hold prior to the event. In short, a semelfactive characteristically does not have a result state, but an achievement does establish a result state.
8.5 Aktionsarten and agentivity

Certain contexts semantically require a predicate which denotes an event with an agent – that is, a ‘doer’ with the potential for control or intention. For example, Jones is an agent in Jones cunningly hid the keys. (Agentivity is discussed in more detail in Chapter 10.) Although agentivity is a matter of argument structure rather than aspect, agentivity and aktionsart do not seem to be entirely independent. In fact, signs of agentivity correlate with aktionsart to such an extent that tests which really signal agentivity were for a long time included as tests for aktionsart. The main tests which show an interaction between agentivity and aktionsart are reviewed here.

Accomplishments and processes can appear in the complement to persuade, but achievements and states cannot, as shown in (40)–(43):

(40)  accomplishment
a. Jones persuaded him to [eat the pie].
b. They persuaded Jones to [build a barn].
c. Jones persuaded Mike to [walk to town].

(41)  process
a. Jones persuaded Tina to [walk in the park].
b. Jones persuaded the group members to [chat].
c. Dino persuaded Jones to [push a supermarket trolley].

(42)  state
a. #Jones persuaded the couple to [be happy].
b. #Lucas persuaded Jones to [understand chaos theory].
c. #Jones was persuaded to [hear the trucks coming].

(43)  achievement
a. #Jones was persuaded to [notice the mark on the wall].
b. #Jones was persuaded to [recognize the woman in the doorway].
c. #Jones was persuaded to [turn fifty].

Accomplishments and processes can be modified by adverbs like carefully or deliberately, but achievements and states cannot, as in (44)–(47):

(44)  accomplishment
a. Jones deliberately ate the pie.
b. Jones built the barn carefully.
c. Mike deliberately walked to town.
(45) process
   a. Tina deliberately walked in the park.
   b. The group members chatted conscientiously.
   c. Jones conscientiously pushed the supermarket trolley.

(46) state
   a. #The couple were happy deliberately.
   b. #Jones deliberately understood chaos theory.
   c. #Jones carefully heard the trucks coming.

(47) achievement
   a. #Jones deliberately noticed the mark on the wall.
   b. #Jones carefully recognized the woman in the doorway.
   c. #Jones conscientiously turned fifty.

Accomplishments and processes can appear in the imperative voice but achievements and states cannot, as in (48)–(51):

(48) accomplishment
   a. Eat the pie!
   b. Build a barn!
   c. Walk to town!

(49) process
   a. Walk in the park!
   b. Chat among yourselves!
   c. Push the trolley!

(50) state
   a. #Be happy!
   b. #Understand chaos theory!
   c. #Hear the trucks coming!

(51) achievement
   a. #Notice the mark on the wall!
   b. #Recognize the woman in the doorway!
   c. #Turn fifty!

The imperative in (50a) is acceptable as a benediction rather than as a command, comparable to May you be happy! Imperatives of the form be + adjective are also often well-formed if they can be interpreted as containing so-called agentive be, as illustrated in (52):

(52) a. Be good!
    b. Be quiet!
    c. Don’t be stupid!
    d. Be nice!
These are not commands to be in a certain state or have a certain property, but are really commands to behave in a certain fashion. Agentive be denotes behaviour and is really a process predicate.

Finally, only agentive predicates are appropriate in the what x did construction, as illustrated in (53)–(56):

(53) **accomplishment**
    a. What Jones did was eat the pie.
    b. What Jones did was build a barn.
    c. What Mike did was walk to town.

(54) **process**
    a. What Tina did was walk in the park.
    b. What the group members did was chat among themselves.
    c. What Jones did was push a supermarket trolley.

(55) **state**
    a. #What the couple did was be happy / be rich.
    b. #What Jones did was understand chaos theory.
    c. #What Jones did was hear the trucks coming.

(56) **achievement**
    a. #What Jones did was notice the mark on the wall.
    b. #What Jones did was recognize the woman in the doorway.
    c. #What Jones did was turn fifty.

To sum up so far, accomplishments and processes may be agentive, but states and achievements, even with a human subject, are not agentive. In particular, achievements such as recognizing, noticing and realizing are mental events which happen to us without being under our control or attainable by effort or intention.

The final point in this section concerns early research on **stative predicates** – predicates which denote states – independently of the general research on **aktionsarten**. Lakoff (1965) identified stative predicates and a number of linguistic tests for stativity, including many of the tests above which actually identify agentivity. The tests interact because, as we have seen, states are non-agentive. Lakoff also observed that state predicates do not take the progressive, as illustrated in (57). Resistance to the progressive is commonly included among the characteristics of state predicates.

(57) a. #Jones is knowing French.
    b. #This box is containing all my worldly goods.
    c. #Jones is being in Frankfurt.
    d. #They are having three children.
    e. #Brigitte is being taller than Danny.

However, Dowty (1979: 173–80) pointed out that many state predicates do take the progressive, in which case the state is understood to be comparatively...
brief or temporary. The progressive (b) examples in (58)–(60) below suggest a more temporary state than the non-progressive (a) examples. In (60), the (b) example is odd unless understood in a context where John’s house is being relocated and is temporarily stranded.

(58)  
  a. We live in London.
  b. We are living in London.

(59)  
  a. The statue stands in the south quadrangle.
  b. The statue is standing in the south quadrangle.

(60)  
  a. John’s house sits at the top of a hill.
  b. John’s house is sitting at the top of a hill.

8.6 Nominal and verbal aspect

Mourelatos (1978) observed that telic predicates are countable, like count nouns (e.g., a dog, three dogs), and atelic predicates are like mass nouns, denoting uncountable but measurable ‘matter’ (e.g., some mustard, a sack of seaweed).

Mourelatos’s examples included those in (61)–(62):

(61)  
  telic and countable
  a. Vesuvius erupted three times ↔ There were three eruptions of Vesuvius.
  b. Mary capsized the boat ↔ There was a capsizing of the boat by Mary.

(62)  
  atelic and uncountable/mass
  a. John pushed the cart for hours / For hours there was a pushing of the cart by John.
  b. Jones was painting the Nativity / There was painting of the Nativity by Jones. (compare: ‘There was four hours of Nativity-painting.’)

The obvious exception to this observation is the case of semelfactives (see Section 8.4), which are characteristically countable (kick the door three times/give the door three kicks) but not telic (# kick the door in a moment). Semelfactives were not generally considered in earlier discussions of aktion-sarten. Setting the semelfactives aside, the correlation telic/count vs. atelic/mass is widely adopted.

Among atelic predicates there are two main kinds which also correspond to a difference in nouns. The examples (25)–(26) and (38) above illustrated the point that if a countable event predicate is understood to denote a repeated series of events, then the whole interpretation is of a process, and is atelic – for example, People arrived for a couple of hours, which denotes a vague plurality of individual arrivals spread throughout the couple of hours. Correspondingly in the nominal domain, a vague plural noun phrase (leaves, little bits of paper) is like a mass noun in being compatible with measure phrases as in (63a), in
contrast to count nouns as in (63b):

(63) a. a pound of flour, a pound of peas, a pound of cashews, ...
   b. # three cubic metres of table, a pint of saucepan, ...

Some mass nouns denote a substance made up of individuals, or aggregate substance, as in (64a). A few of these nouns have corresponding vague plurals which refer to the same (or similar) material, as in (64b):

(64) a. corn (consists of kernels); rice (consists of grains), hair (cf. French plural cheveux), ...
   b. gravel/pebbles; poetry/poems; cattle/cows

Natural aggregates also appear among eventualities with predicates such as hammer and pound which denote a vague plurality of blows forming a process. The three kinds of parallelism are summarized in (65):

(65)

<table>
<thead>
<tr>
<th>nominal</th>
<th>count + number</th>
<th>mass + measure</th>
<th>aggregate + measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>three cups</td>
<td>a litre of milk</td>
<td>a bucket of pebbles</td>
<td></td>
</tr>
<tr>
<td>verbal</td>
<td>paint the wall three times</td>
<td>sleep for three hours</td>
<td>pound the herbs for two minutes</td>
</tr>
</tbody>
</table>

8.7 Closing comment

Aspectual distinctions among event predicates first came to the attention of philosophers because of the different ways verbal aspect and tense are interpreted in combination with different types of predicate. For example, as we have seen (Section 8.2.6) the progressive aspect changes the interpretation and aktionsart of some achievements to denote a process leading up to the actual event, but not the event itself (e.g., Jones was dying (prelude process) for months and finally died (achievement) before Christmas). The progressive does not have this effect with any other type of predicate. Differences also appear with tense forms – for example, the simple present tense (She wears red, He walks to work) has a habitual interpretation with most predicates, but has a ‘right now’ interpretation with some states (I smell smoke, Do you hear that?). The task of giving a consistent formal analysis for tenses and morphological aspects was greatly complicated by these and other aktionsart effects. Consequently, the aspectual classification of events or event predicates has been of considerable interest in the formal analysis of tense and aspect, as we shall see in Chapter 9.
However, the aspectual classes themselves resist precise logical analysis and there is no generally adopted way of representing all the characteristics of event classes in logic-based semantic representations. It is likely that the four classes presented here are not theoretically essential, and are mainly convenient shorthand for easily identifiable combinations of aspectual characteristics. The classifying features of telic vs. atelic, bounded vs. unbounded, durative vs. non-durative, and static vs. dynamic are the essential notions.

EXERCISES

Aktionsart classification

(1) *
Using the linguistic tests in Section 8.2, try to classify the bracketed predicates in the sentences below as reporting accomplishments, achievements, states, processes or semelfactive events, and decide whether the events are singular or plural. Give the feature values for the predicates (±telic, ±durative, ±dynamic, ±bounded).

a. The door [creaked open].
   b. Sam [got the joke] about three minutes later.
   c. Jerry [is a great talker].
   d. Elsa [chewed her way through half a goat].
   e. Liam [picked at his food].
   f. The cheese [was rancid].
   g. James [read some of his strange poems].
   h. A soft light [shone on the hills].

(2) **
Follow the instructions for Exercise (1) – this time you need to identify the relevant part of the sentence as the basic predicate.

a. Max drew his pistol.
   b. Donald heated the solution.
   c. Donald heated the solution to 70 degrees.
   d. Donald heated the solution for five minutes.
   e. Tim doodled on the tablecloth listlessly.
   f. A strange mushroom appeared on the lawn.
   g. Strange mushrooms appeared on the lawn overnight.
   h. Liam talked himself into a rage over the building consent.

(3) **
Follow the instructions for Exercise (2).

a. A shabby warehouse complex came into view.
   b. Anna was cracking nuts.
   c. Anna cracked nuts with a hammer.
   d. Anna cracked the nuts with a hammer.
e. Macbeth became king.

f. Jones won the election.

g. People moved away.

h. The sun set.

(4) *** (recommended for discussion)
The predicates in the sentences below express a change in the state of the entity denoted by the subject. These predicates constitute a particular type in aktionsart terms. Apply the tests for aktionsarten to the sentences, and identify the characteristics of predicates like cool and increase.

a. The solution cooled.

b. The price of gold increased.

For adverbials

(5) ** (recommended for discussion)
Consider the for adverbials in the examples below. What interval does the adverbial modify, and what kind of eventuality occupies the interval? Some of the sentences cannot be given a sensible reading (judgments are not shown). Which are the anomalous sentences, and why is the for adverbial anomalous?

a. Jones found his keys for ten minutes.

b. Jones discovered new recipes for years.

c. Jones discovered the joy of cooking for years.

d. Jones thumped the TV for hours.

e. Jones walked to the corner for several hours.

f. Jones photographed the view for years.

g. Jones solved the mystery for weeks.

h. Jones turned the corner for 30 seconds.

Time adverbials

(6) ***

Preamble:
Some time adverbials can be analysed as a kind of universal quantification. The force of the quantification is that an atelic event occupies every part of the stated interval, for example:

\[ \forall t (\text{IN}(t, I) \rightarrow \text{SLEEP}(j) \text{ at } t) \]

Suppose the whole time interval is made of time-points or intervals represented by \( t \) variables. The way the event occupies the interval can be expressed as:

\[ \forall t (\text{IN}(t, I) \rightarrow \text{SLEEP}(j) \text{ at } t) \]
Other time adverbials with telic predicates express an existential quantification:

\[ \exists t (\text{IN}(t, 1) \land \text{ARRIVE}(j) \text{ at } t) \]

Jones’ arrival doesn’t occupy the whole of Monday, but occurs at some point within it. This can be analysed as:

\[ \exists t (\text{IN}(t, 1) \land \text{ARRIVE}(j) \text{ at } t) \]

**To Do:** Pair the adverbials listed below with the test predicates in the sentences (a)–(c) – what type is each adverbial? Follow the examples in the preamble to give representations for the sentences (a)–(c) modified by the adverbials.

for a week, on Monday, since three o’clock, last week, until midnight, during the film, in May, all day, at night.

a. The radiator rumbled / The radiator will rumble.

b. The radiator broke down / The radiator will break down.

c. The radiator exploded / The radiator will explode.

---

**FURTHER READING**

The main texts in the development of the current *aktionsart* classes are Ryle (1949: Chapter 5), Kenny (1963: Chapter 8) and Vendler (1967: Chapter 4). Ryle discusses the non-agentive quality of achievements, which he calls ‘lucky’ achievements. Kenny develops tests for a three-way division among states, activities and events, and Vendler proposes the four main classes (and their names) reviewed here. All these texts are accessible.

Van Voorst (1992) discusses the aspectual classification of psychological verbs according to the standard tests, with a wide range of data.

Jackendoff (1991) develops an analysis of the conceptual structure components which underlie boundedness and plurality in the concepts of both matter and events (cf. Section 8.6 ‘Nominal and Verbal Aspect’). The discussion is clear with numerous examples.
9.1 Introduction

Both tense and aspect convey temporal information about a described event or state of affairs. Tense locates the whole event or situation on the timeline, in the past, present or future.

(1) past time of utterance = present future

There are two kinds of aspect (though they interact), lexical or predicate aspect and morphological or viewpoint aspect. Lexical or predicate aspect (see Chapter 8) is a property of a basic uninflected predicate such as realize the truth, believe in fairies, and blink, which describe events or states of affairs of different temporal forms, or aktionsarten. Here we consider morphological aspect which is expressed in the morphology of the verb. Unlike tense, aspect does not locate the event on the timeline, and is combined with a separate expression of tense. Rather, aspect can be said to present the reported event or state of affairs as if viewed either from inside the event (‘in progress’) or outside the event (‘as a whole’). Before proceeding to discussion of semantic analysis, the next two sections provide a descriptive review of tense and aspect verb forms, and the range of interpretations of some of the forms in English.

9.2 The English verb group

The English verb group contains the main verb, and may also contain a modal auxiliary and forms of the auxiliary verbs have and be. A verb group containing all these elements together is illustrated in (2):

(2) On the original timetable for this project, by this time the reports would have been being printed.
Example (2) shows the order in which the different verbs always appear, and also illustrates how auxiliary *have* and both auxiliary verbs *be* determine the form of the verb immediately following.

(3)  
<table>
<thead>
<tr>
<th>Modal</th>
<th>Perfective</th>
<th>Progressive</th>
<th>Passive</th>
<th>Printed</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>would</em></td>
<td><em>have</em></td>
<td><em>be</em> + <em>-en</em></td>
<td><em>be</em> + <em>-ing</em></td>
<td><em>print</em> + <em>-en</em></td>
</tr>
<tr>
<td><em>will</em></td>
<td><em>be</em> + <em>-en</em></td>
<td><em>be</em> + <em>-ing</em></td>
<td><em>be</em> + <em>-en</em></td>
<td><em>print</em> + <em>-en</em></td>
</tr>
</tbody>
</table>

The verb following a modal verb is in the stem form.

The verb following perfective *have* is the *past participle*, which is the *-en* form of the verb. Although *-en* is the symbol for all past participle forms, the actual forms may vary, as illustrated in (4):

(4)  
<table>
<thead>
<tr>
<th>Verb</th>
<th>Form</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>be</em> + <em>en</em></td>
<td><em>have</em> been</td>
</tr>
<tr>
<td><em>go</em> + <em>en</em></td>
<td><em>have</em> gone</td>
</tr>
<tr>
<td><em>look</em> + <em>en</em></td>
<td><em>have</em> looked</td>
</tr>
<tr>
<td><em>break</em> + <em>en</em></td>
<td><em>day</em> has <em>broken</em></td>
</tr>
<tr>
<td><em>sing</em> + <em>en</em></td>
<td><em>we</em> have <em>sung</em></td>
</tr>
</tbody>
</table>

The verb following progressive *be* is always the *-ing* form, which is the *present participle*.

In any verb group, formal tense is marked only once, and always appears on the first verb in the sequence. English has only two formal tenses, present and past. The future is most commonly expressed by *will*, which is a modal verb and not a formal tense. In (3) above the modal verb *would* is the past tense form of *will*, and none of the other verbs has a tense marking. The tense forms of the modal verbs are listed in (5):

(5)  
<table>
<thead>
<tr>
<th>Present</th>
<th>Past</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>will</em></td>
<td><em>would</em></td>
</tr>
<tr>
<td><em>can</em></td>
<td><em>could</em></td>
</tr>
<tr>
<td><em>shall</em></td>
<td><em>should</em></td>
</tr>
<tr>
<td><em>may</em></td>
<td><em>might</em></td>
</tr>
<tr>
<td><em>must</em></td>
<td><em>–</em></td>
</tr>
</tbody>
</table>

The separate components of the verb group combined with the two formal tenses and the *will* future are illustrated in (6):

(6)  
<table>
<thead>
<tr>
<th>Main verb alone, active voice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present tense</td>
</tr>
<tr>
<td>Past tense</td>
</tr>
<tr>
<td><em>will</em> future</td>
</tr>
<tr>
<td>Passive voice</td>
</tr>
<tr>
<td>Present tense</td>
</tr>
<tr>
<td>Past tense</td>
</tr>
<tr>
<td><em>will</em> future</td>
</tr>
<tr>
<td>Progressive aspect</td>
</tr>
<tr>
<td>Present tense</td>
</tr>
<tr>
<td>Past tense</td>
</tr>
<tr>
<td><em>will</em> future</td>
</tr>
</tbody>
</table>
Perfect Aspect

<table>
<thead>
<tr>
<th>Tense</th>
<th>Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>present</td>
<td>June has laughed</td>
</tr>
<tr>
<td>past</td>
<td>June had laughed</td>
</tr>
<tr>
<td>will future</td>
<td>June will have laughed</td>
</tr>
</tbody>
</table>

The **passive voice**, marked by passive *be* and the past participle, contrasts with the **active voice**, which is the more basic form of the sentence. In the passive voice, the NP which is the subject of the corresponding active sentence either is missing or appears in an optional *by*-phrase, and the NP which is the object of the corresponding active sentence appears in the subject position. Voice is quite distinct from tense and aspect – voice affects the syntactic argument structure of the verb (see Chapter 2 and Chapter 10) and has no time-related interpretation.

The main interpretations of the perfect and progressive aspects are described in the next section.

### 9.3 Interpretations of present, past, progressive and perfect

#### 9.3.1 Interpretations of the present tense

The interpretation of present tense forms varies according to the classification of the eventuality (see Chapter 8 for detailed discussion of eventuality types) that the verb form describes. The main difference at issue here is the contrast between events and states.

**States** include psychological states such as believing and knowing, physical locations, permanent characteristics, and some perceptual states such as seeing and hearing. With verbs describing states the present tense has a present time reading.

\[(7)\]

a. I *see* the trucks coming.

b. Listen! I *hear* voices.

c. He *believes* this rubbish.

d. She *knows* where we are.

e. All those cupboards *contain* expensive equipment.

f. The house *stands* on a bluff overlooking the upper harbour.

g. Koalas *live* on eucalyptus shoots and leaves.

The present time reading of the present tense is vague in itself, and depends on the particular verb to give a 'right now' reading, as in \((7a, b)\), or a more long-term reading including the time of speaking, as in \((7e, f)\). Sentences like \((7g)\) are classed as generic statements and are also sometimes considered to be semantically timeless, but even generic sentences may have some limitations in time – compare *The dodo was flightless*, which is a generic sentence appropriately expressed in the past tense.
Events are all the kinds of happenings which are not states, including actions. Event verbs in the present tense are most commonly interpreted as habitual. The habitual reading denotes not only habits, but any activity which is repeated from time to time or regularly, as illustrated in (8):

(8)  a. Heath *bikes* to work.
     b. Barry *feeds* the dogs.
     c. She *writes* with a fountain pen.
     d. She *eats* peas but she won’t eat silver beet.

The present habitual does not describe an event occurring at the time of speaking – for example, (8a) does not mean that Heath is on his bike at the time of speaking.

For certain kinds of pre-determined event the simple present tense can also have a future time reading, as in (9):

(9) The sun *sets* tomorrow at 6.03.
     I *leave* for Wellington this afternoon.

It isn’t quite clear what fixes this use of the present tense, but it seems that the event must be either the result of some definite arrangement or fixed as a natural event. Being certain that the event will take place isn’t sufficient to allow the use of the future reading of the present tense. For example, suppose a chess championship is in progress, and there have been a number of cancellations in the preliminary matches. The weakest player has gone forward to the semi-final without any matches and tomorrow will play Sonja, the champion of the previous five years. It seems certain that Sonja will win tomorrow, but a present tense statement cannot be used to predict this:

(10)  a. #Sonja wins tomorrow.
       b. Sonja will win tomorrow.

Sonja’s certain win can be predicted with (10b), but (10a) suggests that the match has been rigged.

The present tense with action verbs has a present event reading in commentaries such as sports commentaries or the commentary on a cooking programme.

(11)  a. Pitama *passes* to Haggerdoorn, Haggerdoorn *passes* to Jones, and he nearly *misses* –
       b. Now I just *add* a few drops of water and *beat* the eggs...

These uses of the simple present tense may be somehow related to the habitual interpretation, as the present tense sounds awkward in the commentary context if it is used to describe something which isn’t a normal part of the routine, such
as the game or recipe, as in (12). The italicized verbs in (12a, b) would sound more natural in the progressive forms as in (12c, d):

(12)  a. ?... now the crowd *moves* onto the field...
    b. ?... and I stir the sauce continually while it thickens, and it *sticks* a little so I *take* it off the heat for a minute...
    c. ...now the crowd is moving onto the field...
    d. ...it’s sticking a little so I’m taking it off the heat...

Finally, the present tense also has a use called the narrative or historic present, with a past time interpretation, as in (13):

(13)  So just last week *I’m going* down Cashel St and this guy *comes* up to me...

### 9.3.2 Interpretations of the past tense

The basic use of the past tense is to indicate past time, as in (14):

(14)  a. Barry *fed* the dogs (yesterday).
    b. In those days I *could* eat anything.
       (cf. These days I *can* eat anything.)

The past tense form is also used to show conditionality, as in (15). In a conditional sentence the past tense may be used of future times.

(15)  About next week – if we *left* early we *could* see the movie.

The contrast between present tense *may* and past tense *might* is also used to mark different kinds of modality, as mentioned in Section 5.1.2, although this distinction seems to be weakening. The contrast is illustrated in the examples in (16):

(16)  a. She *may have fallen* down the cliff – we’re still waiting for the rescue team’s report.
    b. She *might have fallen* down the cliff – thank goodness the safety harness held.

### 9.3.3 Other forms for future and habitual

The verb forms in the examples below are other common ways of expressing semantic tense, as marked:

(17)  **present progressive with future interpretation**
    She *is leaving* tomorrow.

(18)  **be going to with future interpretation**
    She *is going to leave* tomorrow.
idiomatic used to with past habitual interpretation
He used to paint watercolours years ago.

To sum up so far, the present and past tenses are not uniformly interpreted as their corresponding semantic tenses. The past tense frequently has past time meaning but it also conveys conditionality. The present tense has a range of interpretations and is compatible in different forms with past, present and future times.

9.3.4 Interpretations of the progressive

The canonical reading of the progressive was described by Jespersen (1932: 178–80) as a temporal frame: the progressive reports the time of an event or situation as a temporal frame containing another time. Another way of describing the reading is to say that the progressive takes us inside the duration of a reported event to where the event is in progress. The examples in (20)–(22) show the progressive forms for each tense contrasted with the non-progressive forms:

(20) a. Alice reads the Mail.
    b. Alice is reading the Mail.

(21) a. When you arrive John will make coffee.
    b. When you arrive John will be making coffee.

(22) a. When Alice arrived John made coffee.
    b. When Alice arrived John was making coffee.

(20a) has the habitual reading as in (8) above. The progressive in (20b) has the ‘right now’ reading – that is, the time of reading the paper is a frame around the time of speech. In (21b) and (22b) the progressive form of make coffee presents the time of the coffee-making event as a frame around the time of arrival, or in other words, the progressive takes us inside the coffee-making event to where it is in progress. In contrast, (21a) and (22a) are interpreted as reporting a sequence of events in which the coffee-making follows the arrival. These interpretations are diagrammed in (23):

(23)  --------------------------- coffee-making

    (20b) time of utterance

    (22b), (23b) time of arrival

The temporal frame reading is typical of the progressive with event verbs. Some state verbs do not take the progressive at all, as discussed at the end of Section 8.5. With a number of state verbs, however, the progressive form suggests a shortened duration for the state, or suggests temporariness. These points are illustrated in (24): (24a) is ill-formed, and (24c) suggests a comparatively short or temporary state of affairs compared to (24b).
(24)  a. #Jones is owning an old Jaguar.
     b. We live in London.
     c. We are living in London.

9.3.5 Interpretations of the present perfect

The English present perfect is one of the most semantically complex verb forms, and is the subject of considerable debate. Most of the more recent discussion centres on the complex time reference of the present perfect, which appears to span both past and present. Another characteristic of the present perfect is that it generally refers to an unidentified event time which is not contextually familiar – I will return to this point in Section 9.5.

Present time adverbials

Even though the present perfect with an event predicate describes an event which is in the past, it requires time adverbials which denote times or intervals that include the present, so it is incompatible with adverbials like yesterday which denote a completely past time. This is illustrated in (25), where today, this week and since Wednesday identify an interval containing both the reported event and the time of utterance.

(25)  a. Have you read the paper today/this week?
     b. #Have you read the paper yesterday/last week?

(26)  a. Jones has sold three condos since Wednesday.
     b. #Jones has sold three condos last week.

(27)  a. The mail arrived an hour ago.
     b. #The mail has arrived an hour ago.

Current result states

An interval spanning past and present is also evident in the so-called result state reading with event predicates, where the perfect is used to report a past event resulting in a state of affairs which still holds, as illustrated in (28). This is the chief instance of what is generally called the present relevance of the present perfect: a past event is currently relevant because its consequences are still in force. In these examples the state of affairs resulting from the reported event is more pertinent than the event itself.

(28)  a. Jill won’t need that checkout job, she has won the lottery.
     (Jill is now rich.)
     b. Henry can’t dance the pas seul, he has pulled a tendon.
     (Henry is now injured.)
     c. Kane has broken into our files, so we’ll have to whack him.
     (Kane now knows our secrets.)

With typical examples of the result state reading like those in (28), the causing event is understood to be recent, but further examples show that the recency
of the event is partly pragmatic. The resulting state for a result state reading can be identified in completely general terms as the state of an event of the kind described having occurred. So in (28b), for example, the result state is the state of an event of Henry’s pulling a tendon having occurred. This state will hold indefinitely into the future. From the general state of Henry’s having pulled a tendon holding, we can infer other consequences at different times. Given the context suggested in the example, we infer that the injury is still unhealed and therefore that the event is recent, and that we are in the early part of the state of the event’s having occurred.

But from a state of Henry’s having pulled a tendon holding, we can also infer that Henry knows what the pain of a pulled tendon is like, and this consequence, unlike the injury itself, holds indefinitely. So if we say *Henry has pulled a tendon, he knows what it feels like*, the recent event inference is missing.

The same effect is found with utterances of *I have seen your dog*. For example, if the owner is looking for a dog which has wandered off, someone who says *I have seen your dog* implies that he or she knows roughly where the dog is. Here the inference is that the sighting is very recent. But if the owner is trying to describe the appearance of the dog, a rare breed, the speaker implies that he or she knows what the dog looks like, and for this a sighting at any past time is relevant. In both cases, the state of the dog’s having been seen by the speaker is the same state, although its consequences vary at different times.

Another intriguing point about the result state is that it must hold of the subject of the sentence at the time of utterance. Chomsky pointed out the well-known contrast between (29a) and (29b) below:

(29)  a. ??Einstein has visited Princeton.
     b. Princeton has been visited by Einstein.

Example (29a) is comparatively odd because the result state of having visited Princeton is predicated of Einstein, who is dead. In contrast, Princeton still exists and still has the property of having been visited by Einstein, so (29b) sounds fine.

*‘Hot news’ perfect*

The so-called ‘hot news’ perfect also shows a recent event effect, as in (30)–(31):

(30)  a. Russia has invaded Poland.
     b. Krakatoa has blown up.

(31)  a. Jones has had an accident.
     b. The big tree has fallen over.

The hot news perfect is described as appropriate for reporting what is recent news and somehow currently relevant. The examples in (31) are normally interpreted as reporting recent events, but the examples in (30) are odd from a current perspective because they report distant historical events. The ‘hot news’
effect may not be distinct from the recent event effect with result state readings. Plausibly, the hot news effect in (30a) is tied to the inference that Poland is still occupied by Russian troops, and (30b) suggests that the immediate physical aftermath of a volcanic eruption is still unfolding.

In the light of the examples so far, it seems that the present perfect refers to a temporal structure loosely like that diagrammed in (32):

\[(32) \quad \text{interval spanning past and present} = I^* \]

\[
\begin{array}{c}
\text{past} \\
\text{time of described event} \\
\text{future} \\
\text{time of utterance (=} \text{present})
\end{array}
\]

The result state holds at the interval \( I^* \), and \( I^* \) must be contained within the time expressed by time adverbials which can modify the present perfect (\textit{since June, today, this week}).

\textit{Continuing state}

State predicates can have a different reading, as shown by the examples in (33), which describe a state of affairs beginning in the past and continuing up to the present. (The habitual reading of \textit{work} in (33b) is a kind of state.) This is the \textbf{continuing state reading}.

\[(33) \]
\begin{enumerate}
\item a. I have stayed in today. (I am still in.)
\item b. Sheila has worked in the library since December. (Sheila still works in the library.)
\item c. The door has been open for ten minutes. (The door is still open.)
\end{enumerate}

Here we see that the state denoted by a state predicate fills interval \( I^* \), as shown in (34). As with event predicates in the present perfect, a time adverbial must contain \( I^* \).

\[(34) \quad \text{interval spanning past and present} = I^* \]

\[
\begin{array}{c}
\text{past} \\
\text{beginning of described state} \\
\text{future} \\
\text{time of utterance (=} \text{present})
\end{array}
\]

The continuing state reading for a state predicate apparently depends on the presence of an interval adverbial. Compare the examples in (35) and (36) below. The modified (a) examples with continuing state readings contrast quite sharply with the unmodified (b) examples, which sound somewhat incomplete, and do not readily have the continuing state interpretation: (35b) and (36b) both most saliently describe a completely past state of affairs.
(35)  a. They have lived here since 1985.
b. They have lived here.

(36)  a. Donna has had a job at Romero’s this year.
b. Donna has had a job at Romero’s.

On the other hand, a time adverbial does not force the continuing state reading, as (37) shows: both examples describe a completely past state of affairs.

(37)  a. They have lived here since 1985, but not recently.
b. Donna has had a job at Romero’s this year, but not recently.

The completely past reading for a state perfect is like the result state reading for an event perfect. With an event perfect like Jones has read ‘Erewhon’, the result state of Jones having read ‘Erewhon’ holds at the time of speaking, and the reading event is completely in the past. Similarly, on the completely past reading of a state perfect like Donna has had a job at Romero’s, the result state of Donna’s having had a job at Romero’s holds at the time of speaking, but the state of affairs of Donna’s having the job is past.

9.4 Tense as an operator

Tense logic (or temporal logic) analyses tense as an operator of a similar kind to modal operators. We have seen (Chapter 5) that the truth condition for a modal statement breaks the statement into its non-modal form and the world or worlds in which the non-modal form is to be evaluated. For example:

(38)  ‘Mozart might not have died young’ is true (in the actual world) if and only if there is at least one possible world w such that ‘Mozart did not die young’ is true in w.

Tense logic takes a similar strategy: the tensed statement is broken into the non-tensed statement and the time at which the non-tensed statement is evaluated, for example:

(39)  ‘Mozart died young’ is true (at the present time) if and only if there is a time t earlier than the present time such that ‘Mozart die young’ is true at t.

As we saw with modality, the operator can be represented with a shorthand symbol. The modal operators $\eta$ and $\diamond$ are defined in terms of quantification over possible worlds w. The tense operators $\text{Pres}$, $\text{Past}$, and $\text{Fut}$ are defined in terms of quantification over times represented by restricted variables t. The symbols and definitions are shown below. The variable $t^*$ (‘t star’) represents the contextual ‘now’, usually the time of utterance. The symbol $<$ expresses the relation ‘is earlier than’.
(40) a. Clive loves Marcia.
    b. Pres LOVE(c, m)
    c. Pres LOVE(c, m) is true at t* iff LOVE(c, m) is true at t*

(41) a. Fido bit Benny.
    b. Past BITE(f, b)
    c. Past BITE(f, b) is true at t* iff ∃t(t<t* & BITE(f, b) is true at t)

(42) a. Benny will kick Fido.
    b. Fut KICK(b, f)
    c. Fut KICK(b, f) is true at t* iff ∃t(t*<t & KICK(b, f) is true at t)

There are two points to note with these truth conditions. First, in early tense logic the time t at which the sentence was evaluated was assumed to be a single instant. This idea worked for states (John is tall) but was not adequate for statements about events that take more time to unfold, as in Jones made a dish of lasagne. Presumably, the time at which Jones make a dish of lasagne is true is the time the event occupies. Consequently, time intervals were introduced (in interval semantics), and so the times which can be values of the t variables include both instants and intervals.

The second point concerns the interpretation of a statement after the tense is removed. Consider again Fido bit Benny, which is analysed as true at the time of utterance if and only if Fido bite Benny is true at some earlier time. But is Fido bite Benny capable of bearing a truth value anyway?

The problem here is that formal tense in English expresses not only time reference but also what is called finiteness. Finiteness is the syntactic property of a simple declarative sentence which allows it to stand alone and ‘make a statement’. Not all clauses are finite. The bracketed sequences in the (a) examples in (43)–(45) are embedded non-finite clauses, and have no tense on the verb.

(43) a. I heard [Marcia playing jazz]
    b. PLAY(m, j)

(44) a. He wanted [Marcia to give Peter a piano lesson]
    b. GIVE(m, a piano lesson, p)

(45) a. Don’t let [that cat scratch the furniture]
    b. SCRATCH(that cat, the furniture)

In predicate logic each of the non-finite clauses in (43)–(45) can be described as containing all the components for an atomic proposition because each clause contains a predicate combined with its arguments, as shown in the (b) examples.

A proposition is also described as whatever is (or could be) a bearer of a truth value. However, these two ways of defining propositions are not equivalent. All the bracketed clauses in (43)–(45) express complete predicate-argument complexes but none of them expresses a possible truth value bearer — it isn’t possible
to make a statement with any of the forms in (46):

(46)  
   a. Marcia playing jazz.
   b. Marcia to give Peter a piano lesson.
   c. That cat scratch the furniture.

One way to think about $BITE(f, b)$ is true at $t$ is that it amounts to ‘an event of Fido’s biting Benny occurs at time $t$’. A theory with the inventory of types outlined in Chapter 4 doesn’t take this option, because events are not included in the basic types of entities that exist in the theory to be referred to. However, a number of formal theories which do include events in the ontology analyse tense in terms of the occurrence of an event or state of affairs at a time $t$, rather than in terms of the truth of a proposition $p$ at a time $t$. As we shall see in Section 9.6, theories of narrative interpretation refer to events and states of affairs in the analysis of tense.

Basic event semantics will be discussed in Chapter 11. For now, I shall use the simplified forms in (47) to stand for event-based definitions of tense.

(47) **Convention:** $PRED(x)$ at $t$ is interpreted as ‘An eventuality of the kind described by $PRED(x)$ occurs at time $t$.’

   a. Pres $LOVE(c, m)$ iff $LOVE(c, m)$ at $t^*$  
      ‘A state of affairs of Clive loving Marcia holds at $t^*$
   b. Past $BITE(f, b)$ iff $\exists t (t < t^* \& BITE(f, b)$ at $t)$  
      ‘There is a time $t$ earlier than $t^*$ such that an event of Fido biting Benny occurs at $t$’
   c. Fut $KICK(b, f)$ iff $\exists t (t^* < t \& BITE(b, f)$ at $t)$  
      ‘There is a time $t$ such that $t^*$ is earlier than $t$ and an event of Benny biting Fido occurs at $t$’

### 9.5 Tense and reference to times

As outlined in the previous section, the tense operator analysis states that a past tense sentence is true if and only if there is a past time at which the non-tensed sentence is true. But this isn’t adequate, as is shown by Partee’s (1973) famous example I didn’t turn off the stove. Imagine the speaker says this to her husband as they drive onto the motorway on their way out of town for a trip. Given the presence of negation there are two possible scope relations, illustrated in (48) (where $b$ = Barbara):

(48)  
   a. $\exists t (t < t^* \& \neg TURN\ OFF(b, the stove)$ at $t)$
   b. $\exists t (t < t^* \& TURN\ OFF(b, the stove)$ at $t)$

According to (48a), I didn’t turn off the stove is true if there is any past time at which the speaker didn’t turn off the stove, but this is far too loose – all the times before the speaker was born are times at which the speaker wasn’t turning off the stove. According to (48b), I didn’t turn off the stove is true if there
is no past time at which the speaker turned off the stove, or in other words, if the speaker has never turned off the stove – but this is far too strong. As Partee pointed out, the past tense in a statement like this is about a particular time which can be identified from the context – in the context sketched above, the time is probably on the same day, between using the stove and leaving the house for the trip.

The general point is that reporting uses of the simple past tense refer to particular or definite times which must be identifiable from the context. In this characteristic the simple past tense contrasts with the present perfect, as noted by Noah Webster (1789: 226–7), who describes the simple past tense as definite and the present perfect as indefinite.

‘I have loved’ or ‘moved’ expresses an action performed and completed, generally within a period of time not far distant, but leaves the particular point of time wholly indefinite or undetermined. On the other hand, ‘I loved’ is necessarily employed, when a particular period or point of time is specified... ‘I moved’ is the definite time and ‘I have moved’ the indefinite.

We saw in Section 6.6 that indefinite or weak NPs are associated with novel reference, in contrast with the familiar reference of definite or strong NPs. The definiteness contrast noted by Webster gives rise to clear familiarity effects along the same lines. The present perfect denotes an unfamiliar time which cannot be identified with a previously mentioned time, as illustrated in (49)–(50):

(49)  a. Q: What did you do after dinner?  
        A: #I have watched the news.

       b. Q: What did you do after dinner?  
        A: I watched the news.

(50)  a. I’ve never met a man that I didn’t like.  
       b. I’ve never met a man that I haven’t liked.

The response in (49a) is odd because the perfect have watched cannot be interpreted as referring to the same time as the previously mentioned and familiar after dinner; accordingly, the response doesn’t seem to answer the question. Example (50a), attributed to Will Rogers (the singing cowboy), contrasts with (50b): the simple past tense didn’t in (50a) can refer back to the time of meeting, which once mentioned, is familiar – the speaker liked every man at the time he met him. In contrast, the perfect haven’t liked in (50b) cannot be identified with the familiar time of meeting, and the interpretation is that the speaker has liked every man he met at some stage, but not necessarily at the time of meeting.

Compare also the examples in (51):

(51)  a. Have you seen Cats?  
       b. Did you see Cats?  
       c. No, but I’ve seen it since.
The indefinite time reference with the perfect in (51a) has universal force in the question context (compare *Have you ever seen Cats?*). The answer in (51c) is anomalous as a response to (51a). In contrast, the simple past tense in (51b) makes reference to a definite time, here the season of a particular production of *Cats*, and the answer in (51b) is possible. These differences in reference compare directly with the NPs *a bike* and *the bike* in (52):

(52) a. Have you ridden a bike?
   b. Have you ridden the bike?
   c. No, but I’ve ridden a different bike.

The indefinite reference in (52a) has universal force (compare *Have you ridden any bike?*). (52c) is anomalous as an answer to (52a), but it is a possible answer in response to (52b), which asks a question about a definite identified bike.

The role of a particular, contextually identified time in the interpretation of tenses is a crucial part of the other major tradition in the analysis of tense, which is the analysis by Hans Reichenbach.

### 9.6 Reichenbach’s analysis of tense

We have already seen informally that the interpretation of tense involves calculating with at least two different times, one being the utterance time and the other the time at which the reported state of affairs is located. We have also seen that common uses of the past tense place the reported event at some time which is already familiar, and may serve as a reference point. All three of these kinds of times are used in Reichenbach’s analysis, as listed in (53):

(53) Speech Time S  
    Event Time E  
    Reference Time R

- The time of the utterance, or the ‘now’
- The time of the reported event or state of affairs
- A time which can be identified from context, and is used as a reference point in calculating the location of E.

The clearest illustration of the role of the Reference Time R is in the complex tenses which we haven’t addressed till now, the *past perfect* (*He had verbed*) and *future perfect* (*He will have verbed*). I begin with the past perfect.

The past perfect is also sometimes called the past-in-the-past, because the calculation of the time referred to takes two steps back into the past. This is diagrammed in (54) for the past perfect *had left*.

(54) Tom got there at noon, but Molly [had left] at 10.30. E_R_S

![Diagram illustrating the past perfect tense](image-url)
In the complex tenses the auxiliary *have* expresses a past tense. Because *had* is also in the morphological past tense (that is, *have* + past) there are two past tenses expressed in *had*. The first tense takes us from the S time to the R time, which is identified as the time of the previously reported event, Tom’s arrival at noon. The second past tense takes us back from the R time to the time of the event reported in *had left*, which is the E time at which Molly leaves. (The E time is always the time of the event described by the verb form under analysis, in this case *had left.*) The shorthand representation for this interpretation is E_R_S.

The future perfect (also called the past-in-the-future) is calculated in two steps in a similar way, with the R time as a stepping stone.

(55) The car can’t get to the station until three but *Leda [will have arrived] at noon*, so she’ll have to wait.

\[ S \_ E \_ R \]

\[
\begin{array}{ccc}
S & E & R \\
\text{time of utterance} & \text{noon: Leda} & 3.00: \text{The car gets} \\
= \text{present} & \text{arrives} & \text{to the station}
\end{array}
\]

In Example (55) the three times S, E and R are in a known order, because of the information in the adverbials. Other orders for S and E are also possible, because the future perfect doesn’t fix the order of S and E. This is illustrated in (56), where all the indicated situations are possible contexts (a)–(c) for *will have washed any clues away*.

(56) Loney says he’s going out there, but (when he gets there) *the tide [will have washed] any clues away*.

\[
\begin{array}{ccc}
E_1 & E_2 & E_3 \\
\text{past} & \text{future} \\
S & & R \\
\text{time of utterance} & \text{Loney arrives} \\
= \text{present} & \text{at the beach}
\end{array}
\]

a. The high tide peaked two hours ago: E₁ is before S
b. The tide is full now: E₂ overlaps S
c. The high tide is still to come, but will peak before Loney arrives: E₃ is after S

Strictly, the future perfect expresses only E_R & S_R, which can also be shown with a branching notation as in (57):

(57) future perfect \[ S \searrow R \]

\[ E \swarrow \]
Both the complex tenses show how the R time is a time identified from the context, from which we view or locate the reported event, and thus the E time. The R time must be identifiable: compare the examples in (58) which are presented without a context.

(58)  
   a. Did Leah see Harry?  
   b. Harry had finished editing the tape.

We have already seen that the simple past tense in a narrative refers to a particular time, and so (58a) can’t really be understood until it is known what occasion is to be assumed as the time when Leah might have seen Harry. Similarly, (58b) requires a context in which the R time is known – that is, the past time referred to from which the tape-editing is further in the past.

Reichenbach uses the R time to analyse the difference between the simple past tense and the present perfect. In the previous section I outlined one difference between these forms in terms of definite and indefinite reference to times. In Reichenbach’s analysis, the definite time reference of the simple past tense is shown by locating E and R at the same point – we identify E as being the same time as R. In the present perfect, however, the time of the event is not definite, and is only known to be earlier than S. The only known time is actually S, and so S and R are at the same point. Note that two times at the same location on the time line are separated with a comma in the shorthand notation.

(59) The sun set.  
     past tense  
     E, R_S  
     past            future  
     S  
     The sun sets  
     E, R  
     time of utterance  

(60) The sun has set.  
     present perfect  
     E_R, S  
     past            future  
     S, R  
     The sun sets  
     E  
     time of utterance  

Reichenbach’s analysis of the present perfect, with the R time at the present time (= S), also captures the other main property of the English present perfect, which is that it seems to combine simultaneous reference to the past and the present (see Section 9.3.5 above) – although the reported event is in the past, something is also said about the present.

Reichenbach originally proposed two kinds of future tense, one with R = E and one with R = S, to mirror the difference between the simple past tense and the present perfect Reichenbach assumed that time adverbials always modify the R time, and gave the examples in (61) to illustrate his two kinds of future tense.
In fact Reichenbach’s assumption that a time adverbial always modifies R is incorrect, as we have already seen in (54) and (55) above. For example, in *Tom got there at noon but Molly had left at 10.30*, the adverbial *at 10.30* modifies the E time of Molly’s leaving, not the R time which is noon. If we take *Molly had left at 10.30* out of context the scope of the adverbial is ambiguous. The other available sense is that the adverbial modifies R, and the interpretation is ‘By 10.30, Molly had left’.

These examples show that Reichenbach’s proposed future tense with the interpretation S,R,E cannot be identified by assuming that an adverbial always modifies the reference time. Reichenbach’s examples in (61) also suggest that *I shall go tomorrow* and *Now I shall go* should contrast in a way that parallels the present perfect/past tense contrast, but this isn’t strongly evident – and in any case, how would we interpret *Now I shall go tomorrow*? A possible alternative candidate for the S, R,E tense is the use of the simple present tense to denote future events with a pre-ordained quality, as in (62), but this is not an established analysis. Although the adverbial modifies E, not R, the pre-ordained quality of the event holds at S.


But generally Reichenbach’s S, R,E future is not included in theories of English tense, which is analysed along the same lines as the simple past: the reported event happens at a known time and so E and R are at the same point.

(63) The sun will set. S_R, E

Reichenbach’s analysis has been extremely influential, and most theories of tense draw on his insights or use similar ideas.

### 9.7 Reference to times in a narrative

A closely related kind of reference time is of central importance in the interpretation of time sequences in a narrative discourse. This is not exactly the same as Reichenbach’s R time, and I shall use the lower-case variable *r* for the discourse-related idea of reference time. The interpretation of times in narrative is chiefly addressed in *Discourse Representation Theory* (DRT), and the following discussion draws on Kamp and Reyle’s (1993) introduction to DRT. I have simplified some of the notations for convenience.
In interpreting a narrative, one pragmatic rule of thumb (see Exercise 5, Chapter 2) is that events are normally reported in the order they occur – this rule is strongly borne out by the contrast between *He got on his horse and rode into the sunset* and *He rode into the sunset and got on his horse*. But most narrative is not sequenced in such a simple way – this is illustrated in the extract below. The narrator is a guy called Marlowe. The numbered r variables stand for the times at which the eventuality of the linked verb is understood to hold.

(64) I *went* up the stairs. The radio I *had heard* over the telephone was still *blatting* the baseball game. I *read* numbers and *went up front*.

Apartment 204 was on the right side and the baseball game was *right across the hall from it*. I *knocked*, *got* no answer and *knocked* louder. Behind my back *three Dodgers struck out* against a welt of *synthetic crowd noise*. I *knocked* a third time and *looked* out of the front hall window while I *felt* in my pocket for the key George Anson *Phillips* had given me.

Raymond Chandler (1943). *The High Window*

Taking the extract out of context, we don’t know when this part of the story begins, so we assign it the default value of r0 (reference time = zero – the clock is set to zero). The time r0 is the time of the first event I *went up the stairs*, as indicated by the annotation under the verb *went*. The other verbs in the extract are annotated in the same way to broadly indicate their times of occurrence. A time with a higher number is later than a time with a lower number. Note that forward time movement is not constant in the narrative: r2 is established at *went up front* and persists until r3 at *knocked*. *Three Dodgers struck out* reports a sequence of three events, indicating the passage of time within r6. Finally r8 is established at *looked out of the front hall window* and persists for *felt in my pocket*. 
The two past perfects *had heard* and *had given* report events before the current reference time: \( r_0 \) for *had heard* and \( r_8 \) for *had given*. Pragmatically, the past perfects report a kind of flashback and give information from a time before Marlowe’s trip to the building. Both *had heard* and *had given* are interpreted as reporting events before the events narrated in the extract, and therefore before \( r_0 \). (We reconstruct: Marlowe rang the apartment building and heard the radio, and Phillips gave Marlowe the key to the apartment, before Marlowe went to the apartment building.)

### 9.7.1 Reference time movement

The movement of time in a story is analysed as the transition along an ordered series of (discourse) reference times, \( r_1 < r_2 < r_3 \), etc. The reference times do not necessarily form a continuous timeline, as the story can have gaps in it where we understand time to have passed in which nothing of interest happened, as in (65). The first reference time is the time of the princess’ birth, and the next reference time, specified by the adverbial *when she was seventeen*, is evidently seventeen years later. There are no reference times in the gap as nothing germane to the story occurs there.

(65)  Once upon a time the queen of a distant land gave birth to a beautiful daughter. When she was seventeen the princess sneaked out one night and went to the casino.

When events occur in sequence, the reference time changes with the forward movement in time – this is called **reference time movement**. When the narrative pauses to describe situations which occur simultaneously, the reference time movement is temporarily suspended.

The first generalization in reference time movement is that **bounded events advance reference time**, and unbounded events do not (see Section 8.3 for bounded events). The verb forms which do not advance the reference time in the extract in (64) above are *was (still) blating*, *was on the right side*, and *was right across the hall*, all of which are unbounded. The lack of time movement at *felt in my pocket* is explicit in the connective *while* and not based on the boundedness or otherwise of the verb. I add the examples in (66)–(67) below to clarify the point that boundedness, rather than telicity, is the key property in reference time movement.

(66)  On Sunday afternoon Callan [read], [played records], and [tinkered with his model soldiers].

(67)  On Sunday afternoon Callan [read for a while], [played records until 3.00], and [briefly tinkered with his model soldiers].

The bracketed verb phrases in (66) are atelic and unbounded and the salient interpretation does not place Callan’s activities in any particular order. The bracketed predicates in (67), on the other hand, are bounded but not telic,
and the most salient interpretation is that the activities were in the order of narration – in other words, the bounding adverbials produce the reference time movement. A new reference time is set ‘just after’ the previous reference time. How long afterwards counts as ‘just after’ is pragmatic, depending on the timescale of the narrative and the kinds of events reported: compare The phone rang just after he got in the door (ten seconds likely); She married Tad just after she buried her first husband (ten seconds not likely).

There are a number of exceptions to reference time movement with bounded predicates. One common exception is that a change of subject can signal concurrent events, as in (68). The actions of Francis and Judd are understood to occur at the same time.

(68) Francis went up to the front door and peered in the window. Judd quietly moved around the side of the house towards the back.

The other main exception is narrative elaboration, illustrated in (69), where the clauses of the second sentence describe parts of the whole event Freda made a fire.

(69) While we were away Freda made a fire. She found old papers and a few ancient matches in the scullery, and broke up a derelict chair for kindling.

Reference time movement with bounded predicates is also over-ridden by the presence of a time adverbial. An adverbial such as when she was seventeen, the next night, or on Monday, if present, specifies the new reference time. For example, in (70) a new reference time is established by the bounded event applied a thin coat of lacquer to the table-legs, but the when-adverbial replaces this with a new and later reference time.

(70) Tosher [applied a thin coat of lacquer to the table-legs]. [When the lacquer was dry] he [covered the table with an old sheet].

On the other hand, an adverbial such as while I felt in my pocket for the key, meanwhile, or at the same time maintains the current reference time for the event it modifies – in other words, these adverbials prevent reference time movement.

(71) Tosher applied a thin coat of lacquer to the table-legs [while Lou sorted pieces of spare timber for patching].
9.7.2 State/progressive includes reference time: reference time includes bounded event

So far I haven’t said anything about the structure of the reference times represented by \( r_0, r_1, r_2, \ldots \) in (64) above. Given that these times are considered to be times at which the events occur, they must be intervals rather than instants – this can be assumed. Now there are a number of possible ways the reported eventuality can be related to the reference time. The two main candidates are shown in (72) below:

\[(72) \begin{align*}
\text{a. events (telic):} & \quad e \subseteq r \quad [r, [e]] \\
\text{b. states and progressives (atelic):} & \quad r \subseteq e \quad [e, [r]]
\end{align*}\]

It has been widely proposed that events are contained within the reference time, as in (72a), but states and progressives contain the reference time, as in (72b). The subset symbol \( \subseteq \) is used to express the inclusion relation. The difference is illustrated in (73):

\[(73) \quad \text{Lydia took the book down from the shelf and opened it. The children were playing outside, the weather was fine, and she felt up to the challenge of a new dish.}\]

We begin with \textit{Lydia took the book down from the shelf}, which is a telic event contained in its reference time \( r_1 \). The telic predicate resets the reference time as \( r_2 \), just after \( r_1 \). The event \textit{and opened it} is contained in the time \( r_2 \), and the telic predicate \textit{open} resets the new reference time as \( r_3 \), just after the book-opening. Now we come to the progressive \textit{were playing} and the states \textit{was fine} and \textit{felt up to the challenge}. The usual interpretation of these predicates is that they report states of affairs which loosely wrap around the time \( r_3 \) and extend before and after it: hence the proposal that states and progressives contain the current reference time, in contrast to events, which are contained by the reference time. In addition, \textit{were playing, was fine, and felt up to the challenge} all wrap around the same time \( r_3 \) – none of these predicates introduces a new reference time later than \( r_3 \).

9.7.3 Is \( r \) the same as Reichenbach’s \( R \)?

It is generally acknowledged that Reichenbach’s \( R \) and the discourse reference time \( r \) are similar. For clauses in the simple tenses where Reichenbach’s \( E \) and \( R \) are at the same point, \( r \) and \( R \) can’t easily be distinguished, because both \( r \)
and R are identified as the time at which the event is reported to take place. However, in the complex tenses with auxiliary have r and R can be shown to have different functions, as in Example (74) adapted from Kamp and Reyle (1993: 594). The past perfects signal an embedded ‘flashback’ narrative which is entirely placed before R (= r1 just after Fred’s arrival), but has r movement within it.

(74) Fred arrived at 10. He had got up at 5; he had taken a long shower, had got dressed and had eaten a leisurely breakfast. He had left the house at 6.30.

Fred arrived at 10.  
He had got up  
he had taken a shower  
he had got dressed  
\[
\begin{array}{ccc}
\text{ri} & < & \text{rj} & < & \text{rk} \\
\text{get up} & < & \text{take shower} & < & \text{get dressed}
\end{array}
\]

We see here that r1 is set at just after Fred’s arrival at 10 o’clock, and that r1 is the R time for the past perfects had got up, had taken and had eaten – these three events occurred earlier than 10 o’clock. However, the fact that they precede the R time of 10 o’clock doesn’t place them in order, so their r times are also required – these are shown as ri, rj, rk.

### 9.7.4 General principles for temporal interpretation in narrative

The general principles outlined here are quite widely used in theories of narrative interpretation, particularly Discourse Representation Theory (DRT), from which some of the conventions used here are taken. Some of the principles relate to discussion from the previous section.

**Principle A**: The initial reference time is assigned the value r0. The time r0 may be further identified from the context or by a temporal adverbial.

**Principle B**: A temporal adverbial such as a when-clause or the next day, if present, specifies a new reference time = rn+1, where rn is the current reference time.

**Principle C**: If there is no temporal adverbial, a bounded event (in the main clause) at the current reference time rn introduces a new reference time rn+1, which is just after the event. (Bounded events include telic events and atelic events bounded by duration adverbials such as for an hour or until the autumn.)

**Principle D**: Unbounded events do not introduce a new reference time.

**Principle E**: While-adverbials and adverbials such as at the same time retain the current reference time.
Principle F: A bounded event is contained in the current reference time: \( e \subseteq r \).

Principle G: A state or progressive contains the current reference time: \( r \subseteq e \).

Principle H: Reference time movement may be cancelled:

(i) by narrative elaboration (see Example (70): adding detail about an event already reported) or
(ii) by a switch in protagonist (see Example (69): Francis went up front, Judd went round the back).

We can add principles for the interpretation of participial adverbials, illustrated in (75) and (76) below:

(75) *Coming down the stairs*, Mary bumped into the poltergeist.

The present participle is interpreted like a progressive, as the internal part of the event of coming down the stairs coincides with bumping into the poltergeist. The reference time contained within the event in the adverbial is that of the main clause event. In short, a present participle describes an event which contains the current reference time:

**Principle J:** A present participial adverbial denotes an event which contains the current reference time. \( e \subseteq r \)

The event in a past participle is interpreted as occurring before the event in the main clause it modifies. In (76) the event denoted by the past participial adverbial *driven crazy* is understood to have occurred before the event of the main clause *retreated indoors*, and therefore before the current reference time = \( r_2 \).

(76) Gary set up the radio and started polishing his bike. Kate retreated

\[
\begin{array}{c}
\text{r0 event at r0: set r1} \\
\text{event at r1: set r2} \\
\text{event at r2: set r3 indoors, [driven crazy by the noise of the cricket commentary].} \\
\text{event at r_n: r_n < r2}
\end{array}
\]

**Principle K:** A past participial adverbial denotes an event which occurs before the event reported in the main clause. \( e < r \)

### 9.7.5 Adding tense

So far we have placed the times of events and situations in a narrative in order within the story, but haven’t included the general tense placement of the narrated events – for example, the whole narrative about Marlowe in (64) above takes place in the past, or in Reichenbach’s terms, before \( S \). (\( S \) itself is hard to identify for a fictional narrative – presumably it is some fictional later time at which the narrator character writes or tells the tale.) The tense information is
a further, more general, specification on the discourse reference times \( r \), which can be added with Reichenbach’s symbols: \( E \) is the ‘run time’ of the eventual-
ity, \( S \) is the contextually identified present, and \( R \) is the reference time involved
in the interpretation of tense. A sample analysis including tense and the setting
of reference time \( r \) by the principles given in the previous section is shown in
(77) below:

(77)

<table>
<thead>
<tr>
<th>Sentence</th>
<th>Principle</th>
<th>Time Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>I went up the stairs.</td>
<td>Principle A (past tense), Principle F, Principle C</td>
<td>( r_0 ), ( r_0 &lt; S ), ( E \subseteq r_0 ), set ( r_1 ), ( r_0 &lt; r_1 )</td>
</tr>
<tr>
<td>The radio I had heard over the telephone</td>
<td>past perfect, Principle G</td>
<td>( E &lt; R &lt; S ), ( R = r_1 ), ( \text{ri} &lt; r_1 ), ( \text{ri} \subseteq E ) (for upcoming simple tense, ( r ) remains at ( r_1 ))</td>
</tr>
<tr>
<td>was still blatting the baseball game.</td>
<td>past tense, Principle G, Principle D</td>
<td>( r_1 &lt; S ), ( r_1 \subseteq E ), ( r ) remains at ( r_1 )</td>
</tr>
<tr>
<td>I read numbers and</td>
<td>past tense, Principle F, Principle C</td>
<td>( r_1 &lt; S ), ( E \subseteq r_1 ), set ( r_2 ), ( r_1 &lt; r_2 )</td>
</tr>
<tr>
<td>went up front.</td>
<td>past tense, Principle F, Principle C</td>
<td>( r_2 &lt; S ), ( E \subseteq r_2 ), set ( r_3 ), ( r_2 &lt; r_3 )</td>
</tr>
<tr>
<td>Apartment 204 was on the right side and</td>
<td>past tense, Principle G, Principle D</td>
<td>( r_3 &lt; S ), ( r_3 \subseteq E ), ( r ) remains at ( r_3 )</td>
</tr>
<tr>
<td>the baseball game was across the hall from it.</td>
<td>past tense, Principle G, Principle D</td>
<td>( r_3 &lt; S ), ( r_3 \subseteq E ), ( r ) remains at ( r_3 )</td>
</tr>
<tr>
<td>I knocked,</td>
<td>past tense, Principle F, Principle C</td>
<td>( r_3 &lt; S ), ( E \subseteq r_3 ), set ( r_4 ), ( r_3 &lt; r_4 )</td>
</tr>
<tr>
<td>got no answer and</td>
<td>past tense, Principle G, Principle D</td>
<td>( r_4 &lt; S ), ( r_4 \subseteq E ), ( r ) remains at ( r_4 )</td>
</tr>
<tr>
<td>knocked louder.</td>
<td>past tense, Principle F, Principle C</td>
<td>( r_4 &lt; S ), ( E \subseteq r_4 ), set ( r_5 ), ( r_4 &lt; r_5 )</td>
</tr>
</tbody>
</table>
Behind my back three Dodgers struck out against a welter of synthetic crowd noise.

<table>
<thead>
<tr>
<th>Event Description</th>
<th>Tense</th>
<th>Principle</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>I knocked a third time and looked out of the front hall window</td>
<td>past tense</td>
<td>Principle F, C</td>
<td>r6 &lt; S, E ⊆ r6, set r6. r5 &lt; r6</td>
</tr>
<tr>
<td>while I felt in my pocket for the key</td>
<td>past tense</td>
<td>Principle E, G, D</td>
<td>r7 &lt; S, r7 ⊆ E, r remains at r7</td>
</tr>
<tr>
<td>George Anson Phillips had given me.</td>
<td>past perfect</td>
<td></td>
<td>E &lt; R &lt; S, R = r = r7, E &lt; r7</td>
</tr>
</tbody>
</table>

### 9.8 Closing comment

The Discourse Representation Theory approach to tense interpretation relies on reference to events, and therefore events are in the ontology of DRT. The **ontology of a theory** is the inventory of all the kinds of entities that are assumed to exist in the theory – one way to think about this is that if a theory has variables for a kind of entity, then that kind of entity is in the ontology. The ontology for DRT includes variables for events.

On the other hand, the kind of theory that was introduced in Chapter 4 has a much simpler ontology, with two basic types, e (entities) and t (truth values). All the other types are functions, built out of e and t. At this stage the proposals of DRT have not been incorporated into the more traditional kind of model theory.

### Exercises

**Tense operators**

(1) * Using the tense operators *Pres, Past, and *Fut, write formulae for the following sentences. Omit the bracketed material, which is included to make the sense clear.

a. Everyone likes icecream.

b. Jenny had met Claudia (already).

c. Delia thinks Minnie is going to be sick.
d. (When we arrived at the flat), Jones had had breakfast.
e. Jones will have had breakfast.
f. (Harold began building his house that summer. On completing the house,...) ...He would have spent $400,000.
g. (Clara began juggling when she was five. In a few years ...) ...She would be world class.

Tense and scope

(2) **
A semantic tense may be represented as an operator at the beginning of a proposition; (the operator is further defined in terms of quantification over times). This indicates that tenses are scopal expressions, like other expressions which also appear at the beginning of a proposition, such as modals, negation and quantifiers. The sentences below are ambiguous in the possible scopes of tense and a quantifier NP.

Using the tense operators Past, Pres, and Fut, write representations for both readings of the sentences, and give an unambiguous paraphrase for the sense of each formula.

a. All Torah’s friends were rich then.

b. The monarch will address Parliament in 2001

c. Only ten people on the course have previously been women.

(Treat the sequence only ten as a complex quantifier determiner, and for simplicity, represent (c) with a simple past tense.)

Quantification over times

(3) **
The logical definitions for the simple tenses introduce existential quantification over times, as in

\[ \exists t (t < t^* \land \text{LEAVE}(j) \text{ at } t) \]

Other quantifiers may also bind \( t \) variables. Partee (1984:273) discusses the example:

\[ \forall t: \text{MAKE A PHONE CALL}(j) \text{ at } t \] \[ \exists t': t' < t^* \land \text{LIGHT A CIGARETTE}(j) \text{ at } t' \]

which means that every time John makes a phone call, there is a time shortly before phone-call-time at which John lights a cigarette. Suppose we use \( t <^* t' \) to mean that \( t \) is relevantly just before \( t' \). Then the example can be analysed as:

\[ [\forall t: \text{MAKE A PHONE CALL}(j) \text{ at } t] [\exists t': t' < ^* t] \text{LIGHT A CIGARETTE}(j) \text{ at } t' \]

Using this example as a guide, give complete representations for the sentences below, including the italicized adverbs. (You will need to think about the relationship between the times of the two events.)
a. When Mary phones Jimmy Bill always teases her.
b. Clive will never be a millionaire.
c. Marcia usually buys a hat when she shops.
d. When Clive tells a joke Marcia seldom laughs.
e. Mary often met Sam when she was jogging.

Now analyse the scopal ambiguity in

f. The Pope will always be a Catholic.

**Reichenbach diagrams**

Recall that the Reichenbachian diagrams are:

<table>
<thead>
<tr>
<th>Tense Type</th>
<th>Diagram Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present tense</td>
<td>E, R, S (or any order of E, R and S)</td>
</tr>
<tr>
<td>Past tense</td>
<td>E, R_S or R, E_S</td>
</tr>
<tr>
<td>Future tense</td>
<td>S, E, R or S, R, E</td>
</tr>
<tr>
<td>Present perfect</td>
<td>E, R, S or E, S, R</td>
</tr>
<tr>
<td>Past perfect</td>
<td>E, R_S</td>
</tr>
<tr>
<td>Future perfect</td>
<td>S -&gt; R</td>
</tr>
</tbody>
</table>

(4) *

Give the Reichenbachian diagrams for the italicized verb groups below.

I have\(^a\) to buy a present for Marcia. I suppose\(^b\) I will get\(^c\) something nice at the mall, but I can’t afford to spend much because I haven’t been paid\(^d\) for that graphics job. They’re really slack at that firm — if I’d known\(^e\) about them before they rang\(^f\) me I wouldn’t have taken the job. By the time they pay me I will have waited\(^g\) three months — it’s a disgrace.

(5) ** (recommended for discussion)
Can you construct a Reichenbach diagram for the italicized verb group below? If not, why not?

John left for the front. By the time he would return, the fields would have been burnt to stubble.

**The present perfect**

(6) *** (recommended for discussion)
The present perfect might be described as denoting an interval, beginning in the past and extending up to the present, which is filled with a state or situation: either a continuing state (with a state predicate or progressive), or a result state (with an event predicate).
For example:

*Meiling has been here since Tuesday:* the state ‘Meiling is here’ occupies the interval.

*Jones has broken his ankle:* the state ‘Jones has a broken ankle’ occupies the interval.

Some of the data below are not compatible with the outlined analysis.

(i) Can you say what exactly is wrong with the examples that don’t work? (Clue: what wrong meaning do they seem to have?)

(ii) Can you give a pragmatic account of the oddness of (a)? (Examples (33)–(37) in the chapter might be useful.)

(iii) Is the discussion of Example (29) consistent with (b), (c), and (d)?

a. ?Kennedy has been dead.
   b. Kennedy has been dead for many years.
   c. Kennedy has been killed.
   d. ?Kennedy has been killed for many years.

**The present perfect: universal and existential quantification over times**

(7) *** (recommended for discussion)

**Preamble:**

Section 9.3.5 described the ‘continuing state’ reading of the present perfect with a time adverbial, in which a state or progressive predicate may denote a state or event which begins in the past and extends up to the present.

**Continuing state:** They have lived here since 1985.

1985 past present future

they live here

A present perfect state predicate with a time adverbial can also have the ‘completely past’ reading, for example:

**Completely past:** They have lived here since 1985 (but not recently).

1985 past present future

they live here

The two readings can be analysed in terms of existential and universal quantification over the times in the interval:

**Continuing state:** \( \forall t (1985 < t < t^* \rightarrow \text{they live here at } t) \)

**Completely past:** \( \exists t (1985 < t < t^* \& \text{they live here at } t) \)
In the light of the dataset below, consider these questions:

(i) Is the universal/existential contrast a feature of the present perfect, or a property of the adverbials?
(ii) Is the phenomenon related to scope?

a. Gemma has been a juggler since she was five.
b. Jones has been a bank clerk since I saw him last.
c. Marcia was in Fiji last year.
d. Clive listened to the radio between 9.00 and 10.00.
e. Gemma will stay with Sally next week.
f. Since she was five Gemma has been a juggler.
g. Since I saw him last Jones has been a bank clerk.
h. Last year Marcia was in Fiji.
i. Between 9.00 and 10.00 Clive listened to the radio.
j. Next week Gemma will stay with Sally.

(iii) ****

In the sentence pairs below, one version is marked and awkward. Does your answer to (i) and (ii) suggest a way to account for this?

k. They have lived here since 1985, but not recently.
l. Since 1985 they have lived here, but not recently.
m. Donna has had a job at Romero’s this year, but not recently.
n. This year Donna has had a job at Romero’s, but not recently.

Discourse Representation Theory

The principles for the interpretation of times in narrative are repeated below.

**Principle A**: The initial reference time is assigned the value $r_0$. The time $r_0$ may be further identified from the context or by a temporal adverbial.

**Principle B**: A temporal adverbial such as a when-clause or the next day, if present, specifies a new reference time $= r_{n+1}$, where $r_n$ is the current reference time.

**Principle C**: If there is no temporal adverbial, a bounded event (in the main clause) at the current reference time $r_n$ introduces a new reference time $r_{n+1}$, which is just after the event. (Bounded events include telic events and atelic events bounded by duration adverbials such as for an hour or until the autumn.)

**Principle D**: Unbounded events do not introduce a new reference time.

**Principle E**: While-adverbials and adverbials such as at the same time retain the current reference time.

**Principle F**: A bounded event is contained in the current reference time: $e \subseteq r$.

**Principle G**: A state or progressive contains the current reference time: $r \subseteq e$.

**Principle H**: Reference time movement may be cancelled

(i) by narrative elaboration or
(ii) by a switch in protagonist.
**Principle J:** A present participle denotes an event which contains the current reference time.

**Principle K:** A past participial adverbial denotes an event which occurs before the event reported in the main clause.

(8) **\*\***
Using Example (76) in the chapter as a guide, construct an analysis of temporal interpretation for the passage below. There should be a temporal specification for each verb group.

Brian went into the lab. The standby lights were on. Something was humming over at the back of the room, and a faint curious odour hung in the air. He locked the door behind him, turned off his cell phone, and walking quietly over to the fume cupboard, rolled up his sleeves and began assembling his equipment on a nearby bench. When everything was arranged to his liking he began measuring and mixing the materials. He ground the lapis with great care, warmed the bat blood before measuring it, and creamed the butter and sugar properly before adding the eggs. By nine o’clock he was ready to make the final adjustment and place the flask in the fume cupboard. Behind him, the locked door creaked. alerted by the noise, he froze. He had planned so carefully for months, and didn’t want to be foiled now.

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**FURTHER READING**

For general discussion of the meanings of all English tense and aspect forms, see Jespersen (1932), Leech (1971), and Palmer (1987).

Reichenbach’s (1947) paper ‘The Tenses of Verbs’ is short and accessible. Readable reviews of Reichenbach’s theory are also in Hornstein (1990), Chapter 1, and Mittwoch (1995).

Kamp and Reyle (1993) is an advanced textbook in DRT, but not inaccessible. Tense and aspect are covered in Chapter 5, vol. 2. The DRT analysis for the present perfect and the progressive (not covered here) are in pp. 570–93. Kamp (1995) presents a brief introduction to DRT.


A comprehensive and readable overview of viewpoint aspect and aktionsarten is Smith (1997).

Dowty (1986) presents a persuasive alternative analysis of times in narrative, without direct reference to events, and without the assumptions that for states and progressives $r \subseteq e$, and for bounded events $e \subseteq r$. Dowty’s argument emphasizes pragmatics and the significance of the sub-interval property (see Section 8.2.4). The paper is advanced but clear, and the argument draws mainly on concepts that have been introduced in this text. Recommended.
10.1 Introduction

Thematic relations or thematic roles in linguistic theory are general classes of participants in events. It is generally accepted that thematic role theory begins at least with the work of the Sanskrit grammarian Panini in 500–400 BCE. Panini observed that the grammatical forms of nouns (or noun phrases), particularly case-marking, indicated certain broad characteristics of the interpretation of the noun phrase in the sentence.

A number of systems of classification along the same lines – that is, the interpretation of the grammatical form of a noun or noun phrase – have been developed under different names. Terms for this kind of classification (similar but not equivalent) include theta roles, thematic roles, thematic relations, case roles, case relations and participant roles.

Although roles are primarily classified in semantic or conceptual terms, evidence for the significance of thematic roles in language and for the identification of particular roles is mainly syntactic. Thematic roles are assigned to the syntax-semantics interface and have generally played little part in semantic theory. However, more recent developments in research on thematic roles have clarified how the information they encode may be incorporated into semantic representations, in the form of Lexical Conceptual Structures (LCS).

10.2 Traditional thematic roles

Most introductory textbooks in syntax include a section on thematic roles with a list of role names, such as agent, patient, theme, experiencer, goal, benefactive, source, instrument and locative (Aarts 1997: 88), or agent, experiencer, theme, goal, recipient, source, location, instrument, beneficiary, proposition (Carnie 2007: 231), or theme/patient, agent/actor, experiencer, benefactive, instrument, locative, goal, source (Radford 1988: 373). These lists are obviously drawn from the same system, but they’re all slightly different and the terms for some roles
are not used in the same way by different authors. The variation stems partly from the fact that the current ‘basic list’ of roles is an amalgamation of roles from different traditions. This section will include some discussion on areas of different usage or possible confusion.

10.2.1 Agent/Actor and Patient

A simple distinction between A (Agent) noun phrases and P (Patient) noun phrases is central in studies of transitivity and case systems. For now, it will be sufficient to say that the A argument is the ‘doer’ and the P argument is the ‘one done to’, as in (1):

(1) Jones (A) patted Lassie (P).

The distinction drawn here between Agent and Patient developed independently of the original versions of currently used thematic role systems. The A and P arguments are identified largely in terms of their forms (morphology and/or position in the sentence) in transitive sentences with basic action verbs, and it isn’t generally necessary to give very precise semantic definitions to the notions of Agent and Patient as they are used here.

Investigations of the semantic factors that may determine the A and P arguments in a transitive sentence have revealed a range of properties of the arguments, or relations between the arguments, which contribute to the A/P assignment. The main properties which identify an A argument are listed in (2), loosely ranked in order of importance:

(2) A (Agent) factors

animate only
   a. A has volition – voluntary involvement in an event or state.
   b. A has control over involvement in an event or state.
   c. A is wilful initiator or instigator of an event.
   d. A has consciousness, sentience, perception.

animate or inanimate
   e. A is initiator, instigator or causer of an event or state.
   f. A is source of force directed at or against another entity.
   g. A is entity which moves, coming into contact with another entity which is stationary.
   h. A is entity which moves against a stationary background, or relative to another entity which is stationary; in other words, A is the Figure in a Figure + Ground schema.

In contrast to the grammatical tradition, the philosophical investigation of agentivity concerns issues of responsibility and decision-making. In the philosophical tradition, only properties (2a–c) characterize an agent, and even these can be debated. The stricter philosophical notion of agentivity is also used in linguistics, and is the property targeted by the tests for agentivity reviewed in
Section 8.5. Some of these tests are illustrated in (3):

(3)  a. Jones persuaded Bianca to try the veal.
    b. Shut that door!
    c. Jones carelessly left the door open.

In (3a), Bianca is identified as an agent (in the strict sense) because to be persuaded to act entails forming an intention to act; the imperative voice in (3b) shows that shut the door is a predicate which takes an agent, because you can’t order someone to do something unless they can control doing it; carelessly in (3c) indicates that Jones is an agent because the adverb presupposes that Jones had the potential to control his own action concerning the door.

In short, there are two quite distinct senses, one including the other, for the term agent. From now on, I shall reserve agent for the narrow more philosophical sense, and use the term Actor for the more general sense which correlates with grammatical A arguments.

The P (Patient) argument, the typical object of a transitive sentence, is also identified by a range of properties, although these have not been so widely investigated as the Actor properties. Patient properties are listed in ranked order in (4):

(4) Patient which undergoes change
    a. P undergoes change of state to an endpoint in the event; total change of state.
    b. P undergoes movement to a stated endpoint location.
    c. P undergoes change of state in the event, not necessarily to an endpoint.
    P shows ‘affectedness’: P is affected or altered in some way by an event or state.

Patient which does not necessarily change
    d. P is stationary target of contacting movement or action of another entity.
    e. P is target of force directed from another entity.
    f. P has lack of control or causal influence in the event or state.

A comparison of the lists shows two kinds of factor, summarized in (5):

(5)

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>independent and</td>
<td>• volition and control</td>
<td>• undergoes change to specified state</td>
</tr>
<tr>
<td>canonical; strong</td>
<td>• causes event</td>
<td>or location</td>
</tr>
<tr>
<td>factors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>comparative or</td>
<td>• conscious or sentient</td>
<td>• not necessarily conscious or</td>
</tr>
<tr>
<td>relative; weaker</td>
<td>• moving</td>
<td>sentient</td>
</tr>
<tr>
<td>factors</td>
<td>• source of force or energy; (‘energy</td>
<td>• stationary</td>
</tr>
<tr>
<td></td>
<td>source’)</td>
<td>• target of force or energy; (‘energy</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The higher ranking factors are independent of each other in that there is no obvious relation between a total change of state and the presence of volitional or causal involvement. The lower ranking Actor and Patient factors are not independent of each other in the same way, and both can be said to measure comparative degrees of agentivity. Patients identified by lower ranking factors are negatively specified as less dynamic than the other argument. This gives many non-change Patients the vague ‘elsewhere or other’ character loosely described as ‘the thing verbed’.

In some thematic role inventories all the roles are presented as being of the same kind, including agent and patient. I shall follow the strategy of separating these two from the others: Actor and Patient are macroroles, which form a separate two-term system called the action tier, alongside the other roles. I will return to this point presently.

10.2.2 Localist roles

The localist roles are so-called because they are based on a concept of spatial or metaphorical movement or location. Jackendoff (1972: 29–34) identified the main localist roles of theme, goal, source and location or locative. In a movement event the theme is the entity that moves (theme of motion), the source is the entity or location from which the theme moves, and the goal is the entity or location that the theme moves to – this is diagrammed in (6):

(6) a. \[ \text{source} \rightarrow \text{theme} \rightarrow \text{goal} \]

b. [The ball] rolled [out of the bag]
   \[
   \text{theme} \quad \text{source}
   \]

c. [The ball] rolled [into the pocket]
   \[
   \text{theme} \quad \text{goal}
   \]

The examples (6b) and (6c) illustrate a point which may be debated – is the goal role assigned to the pocket or to into the pocket in (6c)? – the same question arises for the source in (6b). I shall assume that the whole prepositional phrase expresses the goal, for consistency with goals like The ball rolled [over there] or The ball rolled [away], in which the goal is expressed without any reference to a particular entity.

In a predication of static location, the theme is the thing located, as in (7), and the place is the location.

(7) [The jug] remained [on the table].
   \[
   \text{theme} \quad \text{location}
   \]

The localist roles are also assigned in a change of state, expressed as a metaphorical movement. For example, The curtain faded is conceptualized as
‘The curtain moved from an unfaded state to a faded state’. Accordingly, the entity which undergoes a change of state is a theme (change-of-state theme or COS theme). If the final state is expressed it can be analysed as a goal as in (8b, c):

(8) a. [The curtain] faded.

| theme |

b. [The sky] turned [purple].

| theme | goal |

c. [Jones] flew [into a rage].

| theme | goal |

A slightly different kind of source role is also considered to occur with certain verbs of emission, as in (9). This kind of source is always expressed as an entity.

(9) a. [The rocks] dripped [water].

| source | theme |

b. [The chimney] belched [thick brown smoke].

| source | theme |

Many verbs of motion occur with a path argument which is neither a goal nor a source, as in (10). The path arguments in these examples do not identify a starting point for movement (source) nor a final location (goal).

(10) a. → → → [theme] → → →

b. [Jones] ran [along the cinder path].

| theme | path |

c. [The glider] drifted [through the clouds].

| theme | path |

If we identify a path argument as an expression of the route of a theme of motion, then goals and sources are also types of paths. The relationship among the terms is diagrammed in (11):

(11) path₁

| goal | source | path₂ |
There is no special name for the kind of path argument which is neither a source nor a goal, and so it is just called by the more general name of path. Path in the narrow sense (that is, \( path_2 \)) is an autohyponym of the general term path\(_1\) — that is, the word path is a hyponym (or subordinate term) of itself. This kind of pattern is a potential cause for confusion in the identification of thematic roles. Strictly speaking, goals and sources may be paths, but the term path is often used in the path\(_2\) sense, referring to an open path (that is, without endpoints).

### 10.2.3 Recipient and benefactive

I said earlier that the image of movement which underlies the localist roles can be spatial or metaphorical. A special metaphorical field is the field of possession, which has a distinct goal role, that of recipient. The recipient is the entity into whose possession a theme moves, as in Jones gave the scraps [to the dog]. The main difference between general goals and recipients, and motivation for having a separate recipient role, is that recipients can be expressed in double object constructions. In the examples below the (b) example is a double object construction – two noun phrases follow the verb without any preposition such as to.

\[
\begin{align*}
\text{(12) a. Liam showed [the photos] [to his girlfriend].} \\
\text{   theme recipient} \\
\text{b. Liam showed [his girlfriend] [the photos].} \\
\text{   recipient theme}
\end{align*}
\]

The double object form cannot be used with a non-recipient goal, as shown by the anomaly of (13b):

\[
\begin{align*}
\text{(13) a. Jones whacked [the ball] [to the boundary].} \\
\text{   theme goal} \\
\text{b. \#Jones whacked the boundary the ball.}
\end{align*}
\]

A similar pattern identifies the benefactive argument (also sometimes called beneficiary). Broadly, the benefactive is the argument which is intended to possess the theme but may not actually do so. The double object with a benefactive alternates with a for-PP.

\[
\begin{align*}
\text{(14) a. Jones made [a new kennel] [for the dog].} \\
\text{   theme benefactive} \\
\text{b. Jones made [the dog] [a new kennel].} \\
\text{   benefactive theme}
\end{align*}
\]
10.2.4 Experiencer and stimulus

Verbs of perception and emotion are the so-called psych verbs. All psych verbs have one argument which feels or perceives, called the experiencer. Perception verbs generally also have an argument for the thing perceived, called the stimulus. Emotion verbs may also have a stimulus argument, which is the entity that provokes the emotion.

(15) a. [Jones] saw [the approaching posse].
   | experiencer             stimulus |

b. [Lassie] smelt [smoke].
   | experiencer    stimulus |

c. [Ruth] enjoyed [the cable car ride].
   | experiencer            stimulus |

d. [The movie] bored [Simon].
   | stimulus          experiencer |

I began by saying that thematic roles are broad semantic classes of arguments associated with a particular syntactic realization, by case-marking (e.g., the different pronouns forms he and him, she and her) and/or by position in the sentence (e.g., subject, indirect object). A major puzzle with the psych verbs is that they do not seem to express the arguments systematically: both experiencer and stimulus can be expressed as either subject or object, as shown in (15). Pesetsky (1995: 55–60) argues that the problem can be clarified by reanalysing the stimulus role, which is not the same in the two verb classes, called subject-experiencer and object-experiencer verbs. Much of Pesetsky’s detailed argument draws on syntactic theory – I shall outline only a couple of points here. Pesetsky observes that the stimulus subject of an object-experiencer verb causes or provokes the emotion, but the emotion need not be directed at the stimulus argument. In (16a), for example, the article causes Thomas to become enraged about something, but he may approve of the article itself and agree with it. In (16b), the television set may cause John to worry about some issue which is not the television itself – for example, an expensive television set in his son’s room may make him worry about how his son got the money to buy it. In these cases, Pesetsky argues, the so-called stimulus is really a causer argument (which falls under the macrorole of Actor; see Section 10.2.1).

(16) a. [The article] enraged [Thomas].
   | causer-stimulus       experiencer |

b. [The television set] worried [John].
   | causer-stimulus              experiencer |
With a subject-experiencer verb, on the other hand, the emotion must be directed towards the stimulus, as in (17). (Pesetsky also distinguishes between target stimulus and subject matter stimulus, but I shall use the term target to cover both.)

(17) a. [Midge] loves [ice cream].
   | experiencer    | target-stimulus
b. [Jones] feared [the poltergeist].
   | experiencer    | target-stimulus

Verbs which take a propositional argument, such as think, believe, hope, fear, and so on, are not often discussed in thematic relations studies, but plausibly can be included with subject-experiencer verbs. The proposition argument is understood to be the target or content of the experiencer’s thought, often with a kind of emotional attitude towards the proposition expressed as well.

(18) a. [Jones] feared [that he would be too late to see the fireworks].
   | experiencer    | target-stimulus
b. [Jones] had always believed [that oysters were poisonous in May].
   | experiencer    | target-stimulus

10.2.5 Do adjuncts have thematic roles?

Earlier studies included both arguments to the main verb and also adjuncts in the inventories of thematic relations. (Adjuncts are modifier expressions which are not syntactic arguments of the verb – see Section 2.3.1 for arguments and adjuncts.) The last of the common traditional roles to be considered here is instrument, which is realized in an adjunct with-phrase, as in (19):

(19) a. He opened the door [with an old key].
   b. She mixed the concrete [with a piece of broom handle].

In later developments of the theory, thematic relations were classified as part of the meaning of the verb, assigned by a verb to its arguments – the term theta role (also written as θ role with Greek letter θ = theta) denotes a role assigned by a predicate in syntax. The inventory of theta roles assigned by a verb was included in the verb’s entry in the lexicon, in the form of a theta grid, as illustrated in (20):

(20) give <agent, theme, recipient>

Some of the traditional thematic roles are not determined by the verb and are syntactic adjuncts, like the instrument role in (21). Adjunct relations can
be analysed as assigned by the characteristic preposition, rather than by the main verb they modify. For example, the instrument role is in the argument structure of one sense of the preposition *with*, and the benefactive role can be analysed as assigned by one sense of the preposition *for*, rather than by a verb. The association of roles with predicates is illustrated in (21):

(21) [Tom] served [Sally] [spaghetti] with [a silver spoon].

The distinction between arguments of a verb and adjuncts also sharpens the contrast between different kinds of locative expression. In Jackendoff’s original outline the locative thematic relation was assigned to the expression of location predicated of a theme, as in (22):

(22) Jones is [in the garage].

This does not include more general adverbials of place which locate a whole event, as in (23) – these are called frame locatives, and are not included under theta roles.

(23) Gina and her friends met for a game of basketball [in the park].

Although (23) entails that Gina and her friends were in the park, the location is not predicated of them directly, but follows only because they are part of the whole state of affairs which is in the park. The analysis of these kinds of adverbials will be discussed further in Chapter 11.

Early theories of thematic relations focused mainly on the way entities participated in events. The shift to the theta role view suggests that certain non-entity expressions which are required by a verb (and so apparently are arguments) may also receive theta roles. Verbs like *cost* and *weigh* generally require an expression of *measure*, which is usually the direct object, as in (24):

(24) a. The whole set costs [two thousand pounds].
   b. The rig weighs [five tons].
   c. The bucket holds [nine litres].

Finally, verbs of behaviour such as *behave*, *act* and *treat* require an adverbial of manner – if all obligatory phrases (with a particular verb) are arguments and all arguments are assigned a theta role, then this suggests that there is a role of manner.

(25) a. They treated him [very well].
   b. He acted [like a fool]. (Does not mean ‘He played a part in a play foolishly’.)
   c. The dogs behaved [impeccably].
10.2.6 Themes and Patients

I noted earlier that the term *path* can be autohyponomous, in the pattern repeated in (26) below. The kind of path that has neither a source nor a goal is just called a path, but in this sense (that is, meaning ‘open path’), *path₂* is a hyponym of *path₁* – that is, *path* is a hyponym of itself, or autohyponym.

(26)

<table>
<thead>
<tr>
<th>path₁</th>
<th>path₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>goal</td>
<td>source</td>
</tr>
<tr>
<td><em>to the lighthouse</em></td>
<td><em>from the mirror</em></td>
</tr>
</tbody>
</table>

A similar pattern arises with the macrorole Patient. The canonical properties for a Patient (see (5) above) are change of state and change of location, so themes are canonical Patients. But there are also other non-theme Patients which are simply called patients, as illustrated in (27): *patient* is a hyponym of *Patient*.

(27)

<table>
<thead>
<tr>
<th>Patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>motion theme</td>
</tr>
<tr>
<td><em>Jones lifted [the tarpaulin]</em></td>
</tr>
</tbody>
</table>

Some authors also use the term *theme* to denote the macrorole of Patient, so that the theme role is assigned to any argument with object-determining properties as in (5) above. This variation in terminology can be confusing, but it should be easier to navigate if you know where the variation in usage occurs. The usage assumed in this book is summarized in the next section.

10.2.7 Summary

The table below summarizes the relationships among roles that have been discussed so far. As we see, the roles are not related in a simple list. There are three distinct tiers or domains. The action tier makes a two-way division into Actor and Patient, according to greater or lesser degrees of dynamism or autonomy in the event. The Actor macrorole has two commonly used sub-roles, agent (for volition and control) and causer (usually for non-agentive causation, such as by natural forces), but these roles are still part of the Action tier. The roles of the Event tier concern spatial or metaphorical location or change, and what I have called the Psych tier contains roles in mental events.
(29) a. [Jones] dashed [out the door].
   Actor-agent  path
   theme

b. [Jones] seized [the ball].
   Actor-agent  Patient
   recipient  theme (metaphorical motion; ball comes to be in Jones' possession)

c. [Jones] sent [emails] [to everyone he knew].
   Actor-agent  Patient
   source  theme  recipient

d. [Jones] absolutely loved [the circus].
   Actor  Patient
   experiencer  target-stimulus
e. [The circus] thrilled [Jones].  

Actor-causer

Patient

experiencer

Thematic relations are very widely used, particularly in discussion of the syntactic patterns they are associated with. Most theorists who refer to thematic relations use the simple names for roles as a convenient shorthand for notions which are in fact complex, and have been further analysed. The further analysis or decomposition of thematic roles is discussed in the next section.

10.3 More detailed analysis of thematic roles

The transition from lists of theta roles in the lexical entry of a verb to a more articulated representation was motivated by a number of considerations. One central idea is that the lexical entry presumably contains a full specification of the verb’s actual meaning along with its phonology, morphology and syntactic characteristics. Little attention was generally paid to developing detailed meaning representations, though a noted exception, much cited, is Guerssel and colleagues’ (1985) analysis of the verb cut:

\[(30) \ x \text{ CUT } y:\]
\[x \text{ produce CUT in } y, \text{ by sharp edge coming into contact with } y\]
\[x \text{ produce separation in material integrity of } y \text{ by sharp edge coming into contact with } y.\]

An analysis like this must include variables for the arguments, because the number of arguments and the nature of their involvement is part of the meaning to be defined. Ideally, the thematic role of each argument should be coded in the way the variable appears in the meaning specification. We can infer from the definition in (30) that \(y\) undergoes a change of state in suffering a ‘separation in material integrity’, but the change of state is not directly symbolized, only implicit. So one motivation for developing a new kind of analysis for verbs was to define their meanings in such a way that the roles borne by the arguments were made explicit.

It was also shown that for some verbs, a satisfactory theta grid (in the form of a list of role names) cannot be constructed at all. For this point we need a little syntactic background.

Recall that thematic relations and theta roles are broad meanings associated with syntactic and/or morphological forms. For example, we care about the Actor/Patient distinction because it determines which argument is the subject and which is the object. Many syntactic theories concerning theta roles propose two main principles to govern the way theta roles are associated with forms (though the exact form of the principles may vary). The first principle is the Theta Criterion:

\[(31) \text{ The Theta Criterion}\]

Every argument receives exactly one theta role, and every theta role is assigned to exactly one argument.
The application of the Theta Criterion has to take into account the possible combinations of macroroles with basic roles (see Example (29) above): the main point for the present purpose is that a predicate cannot assign the same role to two of its arguments.

The other general idea from syntax has a number of versions, the two most widely used being the Uniformity of Theta Assignment Hypothesis (UTAH, pronounced like the state) and the Universal Alignment Hypothesis (UAH). The general idea of what I shall call Uniform Assignment is paraphrased in (32).

(32) Uniform Assignment (UA)

A given theta role is uniformly assigned to the same grammatical kind of phrase (e.g., subject, object, indirect object).

We have already seen that Actors are expressed as subjects and Patients are expressed as direct objects in an active voice sentence. According to UA, all theta roles show the same kind of consistency. You may notice that we already have some apparent exceptions to UA, particularly with the benefactive (He made a trellis [for me], He made [me] a trellis) and the recipient (She sent a postcard [to him] / She sent [him] a postcard), both of which have two forms, not just one as the UA would predict. Problems like this are a major reason that the general idea of UA has so many forms, trying to find the generalization that works. Nevertheless, some particular patterns of theta role expression are widely agreed, particularly Actor and Patient.

Bearing in mind the Theta Criterion and UA, we can now turn to Rappaport and Levin’s (1988) demonstration that theta grids do not give enough information about theta roles and argument expression, using the so-called spray/load alternation.

We have already seen that verbs like give can express their arguments in two ways (Jones gave a bone to the dog / Jones gave the dog a bone). This phenomenon is called argument alternation or occasionally verbal diathesis. The spray/load alternation is illustrated in (33)–(34):

(33) a. Jones loaded [the hay] [onto the truck]. PUT variant
b. Jones loaded [the truck] [with (the) hay]. with variant

(34) a. Hermione draped [the wet rags] [on the unfinished sculpture].
b. Hermione draped [the unfinished sculpture] [with the wet rags].

A noted characteristic of the spray/load alternation is the holism effect associated with the direct object in both variants: the direct object is understood to be totally (or holistically) involved or ‘used up’ in the event. This point is illustrated in (35):

(35) a. Jones loaded [the hay] onto the truck...
   !...and put the left-over hay in the barn.
   ...and there was still room for the piano.
b. Jones loaded [the truck] with the hay ...
   ... and there was still room for the piano.
   ... and put the left-over hay in the barn.

In (35a) the hay is the direct object and the hay is understood to be completely involved in the event, or in other words, Jones put all of the hay on the truck, so the continuation about left-over hay is odd. (I have indicated oddness with ‘!’, though the effect is not as strong as a logical contradiction.) The truck in (35a) is not necessarily understood to be fully loaded, so the continuation about the piano is fine. In (35b), on the other hand, the direct object is the truck, and the truck is understood to be fully involved in the loading – that is, full of hay. Here the continuation about the piano is odd. The hay is not understood to be fully involved in (35b), so the continuation about left-over hay is fine.

At first, the holism effect seems to support UA concerning the expression of themes. We saw in Section 10.2.1 that undergoing change (of property or location) is a canonical property of Patients, and so themes are canonical Patients because undergoing change characterizes themes. Therefore themes, as typical Patients, are expressed as direct objects. In the spray/load alternation it looks as if the strongest version of change – that is, complete change – identifies the theme which is the sentence Patient and therefore the direct object. This would explain why the holism effect attaches to the direct object. If we try to express this insight in terms of theta grids for the PUT variant and the with variant, we need a new theta role for the with-phrase, as in (36). We know that the hay is the theme in (36a), and all of it is loaded, but in (36b) the truck is the completely filled theme and so the hay cannot also be a theme – recall that the Theta Criterion states that a particular verb cannot assign the same role to more than one argument. Following Rappaport and Levin’s discussion I have used the term medium for convenience.

\[
\begin{array}{ccc}
(36) & a. & [\text{Jones}] \text{ loaded } [\text{the hay}] \text{ onto the truck} \\
 & & \text{PUT variant} \\
 & | & | \\
 & \text{agent} & \text{theme} & \text{goal} \\
 b. & [\text{Jones}] \text{ loaded } [\text{the truck}] \text{ with the hay} \\
 & & \text{with variant} \\
 & | & | \\
 & \text{agent} & \text{theme} & \text{medium?}
\end{array}
\]

A difficulty with this analysis is that it cannot account for a key entailment relation between the two variants. The with variant entails the PUT variant, but not vice versa.

\[
\begin{array}{c}
(37) & a. \text{Jones loaded the truck with hay entails Jones loaded hay onto the truck.} \\
 & b. \text{Jones loaded the hay onto the truck does not entail Jones loaded the truck with hay.}
\end{array}
\]

The entailment relation cannot be shown in terms of the two proposed theta grids <agent, theme, goal> and <agent, theme, medium>: in particular, we
cannot show that the ‘medium’ argument is also entailed to be a theme of motion.

Rappaport and Levin conclude that the with variant is semantically more complex, and contains (therefore entails) the PUT variant. This relationship is explicit in their Lexical Conceptual Structures (LCS) shown (slightly adapted) in (38)–(39):

\[
(38) \quad \text{[Jones] } x \text{ loaded } [\text{the hay}] y \text{ onto the truck} z \quad \text{PUT variant}
\]

LCS for load: \( x \text{ CAUSE} [\text{BECOME} [y \text{ on } x]] \)

\[
(39) \quad \text{[Jones] } x \text{ loaded } [\text{the truck}] z \text{ with } [\text{hay}] y \quad \text{with variant}
\]

LCS for load: \( x \text{ CAUSE} [\text{BECOME} [\text{loaded}(z)]] \)

BY MEANS OF \( [x \text{ CAUSE} [\text{BECOME} [y \text{ on } z]]] \)

This analysis gives the desired results. First, the with-variant entails the PUT variant as the definition of the with variant contains the definition of the PUT variant. The PUT variant does not entail the with variant. Second, the hay is shown to be a theme of motion in both variants, because both LCSs contain the clause \( \text{BECOME}[y \text{ on } z] \). Third, Rappaport and Levin propose that the expression of arguments is determined by the main clause of the LCS. Accordingly, the embedded BY MEANS OF clause in the with variant is not involved in argument expression. The main clause of the with variant \( \text{ x CAUSE} [\text{BECOME} [\text{loaded}(z)]] \) – entails that \( z \) undergoes a change of state, thus predicting that \( z = \text{the truck} \) will be the direct object, as it is a COS theme.

More generally, Rappaport and Levin argue that theta role labels are shorthand for patterns in the LCS of verbs, including the common roles in (40). The generalized representations are called schemata (= plural of schema) or sometimes sub-schemata.

\[
(40) \quad \begin{align*}
\text{a. agent} &= x \text{ in } x \text{ CAUSE} [... ] \\
\text{b. theme} &= y \text{ in } \text{BECOME} [\text{predicate}(y)] \\
\text{c. goal} &= z \text{ in } \text{BECOME} [\text{be-at}(y, z)]
\end{align*}
\]

Rappaport and Levin’s LCS converges with earlier work in lexical decomposition. The most influential theory of lexical decomposition of predicates is Dowty (1979), but Miller & Johnson-Laird (1976) also propose extensive decompositional analyses for a wide range of predicates. Dowty’s theory has been adopted and expanded within Role & Reference Grammar, particularly in Van Valin and LaPolla (1997). Decompositional analyses (that is, below the level of the word) are also called lexical semantic representations (LSR) and sometimes referred to as logical forms (LF) or semantic forms (SF).

Dowty’s theory was intended as an analysis of aspectual classes of event predicates, or aktionsarten (see Chapter 8), reflecting the temporal structure of events rather than the thematic structure of predicates. However, later discussion demonstrates that his analysis is more thematic than aspectual, though researchers who use his theory differ on whether or not they consider the analysis to be thematic, aspectual, or both. In the next section I shall draw on
Van Valin and LaPolla’s expanded version of Dowty’s analysis, and shall comment on a couple of points which primarily concern aspecual differences.

### 10.4 Lexical conceptual structure and thematic roles

The formulae of LCS use a version of logical notation with certain added conventions:

- Operators are general event components including BECOME and CAUSE, symbolized in upper-case. An operator takes at least one event argument.
- An event argument is enclosed in square brackets.
- Non-operator predicates which are part of the LCS for the verb are in boldface.
- These conventions will become clearer as we proceed.

#### 10.4.1 The action tier

The macroroles Actor and Patient are not directly symbolized, being determined by the basic roles, but various sub-types of Actor are analysed. Dowty proposes an operator DO to symbolize true agentivity involving volition and/or control. The first argument of DO is an entity and the second is the event:

\[
\text{DO (j, [walk(j)])}
\]

Van Valin and LaPolla’s version of Dowty’s analysis retains Dowty’s intention to represent aspecual event classes, including the difference between processes and states. They observe that in Dowty’s representations a state such as John is asleep is asleep(j), and a non-state such as The flag fluttered is flutter(the flag). Both formulae have the general form of predicate(x) which does not show the difference between states and simple non-states. Van Valin and LaPolla add the generalized activity predicate do to mark simple non-states, as in (42):

\[
\begin{align*}
\text{a. Jones is asleep.} & \quad \text{asleep(j)} \\
\text{b. The flag fluttered.} & \quad \text{do(the flag, [flutter(the flag)])}
\end{align*}
\]

The generalized activity marker do also indicates lower-ranked kinds of Actor – for example, the flag in (42b) has the Actor property of being in motion. A causer argument is the first argument of the CAUSE operator, as in (43):

\[
\text{CAUSE [the sun, [BECOME [melted(the chocolate)]]]]}
\]

In philosophical tradition causation is generally considered to be a relation between events, not between an entity and an event, so many researchers do not allow the first argument of CAUSE to be an entity, as in (43). Instead, an
unspecified action of the entity (symbolized with the general activity predicate \textit{do}) is shown as the causing event. The two styles of analysis are shown in (44). I shall assume that an entity can be a causer for the purposes of natural language semantics, as shown in (44c). At this point I shall also adopt a common convention of ordering the arguments of \textit{CAUSE} before and after the operator – this makes the representations easier to read.

(44) a. The branch broke the window.  
    b. \underbrace{\textit{do}(\text{the branch})} \ CAUSE \ [\text{BECOME} \ [\textit{broken}(\text{the window})]] 
    causative event  
    c. \underbrace{\text{the branch}} \ CAUSE \ [\text{BECOME} \ [\textit{broken}(\text{the window})]] 
    causative entity

The general schemata for types of \textit{Actor} are shown in (45).

(45) agent = x in \textbf{DO}(x, [...])
    causer = x in \underbrace{x} \ CAUSE \ [...]  
    or \underbrace{\textit{do}(x)} \ CAUSE \ [...] 
    non-agentive, non-causative \textit{Actor}  
    = x in \underbrace{\textit{do}(x, [...])}

In principle, the \textit{DO} operator may take variable scope, reflecting which part of the event is included in the agent’s intention. For example, the difference between deliberate and accidental window-breaking can be analysed as in (46):

(46) a. Jones broke the window.  
    b. \textbf{DO} (j, \underbrace{\textit{do}(j)}) \ CAUSE \ [\text{BECOME} \ [\textit{broken}(\text{the window})]]  
    Jones intentionally did this bit – he didn’t mean to break the window.
    c. \textbf{DO} (j, \underbrace{\textit{do}(j)}) \ CAUSE \ [\text{BECOME} \ [\textit{broken}(\text{the window})]]  
    Jones intentionally did this bit – he intended to break the window.

The differences in the scope of agentivity shown here are generally not part of the meaning of a predicate, and sentences like \textit{Jones broke the window} are vague or undetermined on the difference between (46b) and (46c). In the following discussion, I will not comment on possible variations in the scope of the \textit{DO} operator.

The presence or absence of agentivity in the interpretation is often pragmatic, depending on the kind of entity denoted by the subject. In the examples in (47) the subjects are different kinds of \textit{Actor} and cause the window-breaking in different ways. Jones is agentive because he had the potential to control his action, but the branch and the storm are not agentive. The branch is understood
to have broken the window by striking it, whereas (47c) can be understood in quite vague terms, such as ‘The window got broken in the storm’.

(47)  
\begin{enumerate}
  \item a. Jones broke the window.
  \item b. The branch broke the window.
  \item c. The storm broke the window.
  \item d. LCS causative \textit{break}: \textit{x CAUSE [BECOME [broken(y)]]}
\end{enumerate}

The issue of agentivity is relevant for the possible inclusion of other agent-sensitive expressions such as \textit{deliberately} or \textit{accidentally}, which are appropriate only for (47a). But these kinds of differences are not part of the meaning of the causative verb \textit{break}, and therefore the agentive operator \textit{DO} is not in the LCS for the verb – see (47d). In other words, the verb \textit{break} is unspecified for agentivity but the sentential context may add agentivity, which will appear in a decompositional analysis of the whole sentence meaning.

### 10.4.2 Theme, goal and location

Consistent with Rappaport and Levin’s proposal (see (40) above), the COS theme and goal can be analysed as in (48a, b). The theme of location is the first argument of \textit{be-at}, and location is the second argument of \textit{be-at}, as in (48c, d):

(48)  
\begin{enumerate}
  \item a. theme $= y$ in \textit{BECOME [predicate(y)]}
  \item b. goal $= z$ in \textit{BECOME [be-at(y, z)]}
  \item c. theme of location $= y$ in \textit{be-at(y, w)}
  \item d. location $= w$ in \textit{be-at(y, w)}
\end{enumerate}

If the verb expresses a particular spatial relation this can be shown by different forms of the \textit{be} predicate:

(49)  
\begin{quote}
  Jones inserted the key in the lock.
  \textit{DO(j, [CAUSE [BECOME [be-in(the key, the lock)]]]})
\end{quote}

The other motion event roles (source, path, theme of motion) are more complex and are discussed separately in Section 10.4.4 below.

### 10.4.3 Experiencer and stimulus

The object-experiencer verbs are analysed along the same lines as in Pesetsky’s discussion (see Section 10.2.4). The stimulus is analysed as a causer, and the experiencer is the first argument of a general predicate of emotion \textit{feel} (Van Valin and LaPolla: 103).

(50)  
\begin{enumerate}
  \item a. The article angered Jones.
  \item b. the article \textit{CAUSE [BECOME [feel(j, angry)]]}
  \item c. causer-stimulus $= x$ in \textit{x CAUSE [BECOME [feel(y, predicate)]]}
  \item d. experiencer (emotion) $= y$ in \textit{feel(y, predicate)}
\end{enumerate}
The subject-experiencer verbs are not decomposable with the tools we have seen so far, and Van Valin and LaPolla (p. 115) treat them as simple predicates, as in (51). Accordingly, there is no general definition for the associated thematic roles of experiencer and target-stimulus.

(51) LCSs for subject-experiencer verbs: know(x, y); want(x, y); consider(x, y); love(x, y)

Nevertheless, the expression of these arguments can still be thematically predicted by the macroroles. The meanings of verbs like know and want entail that the experiencer argument is conscious, but no such entailment holds of the target-stimulus. Recall Pesetsky’s argument that the target-stimulus is not a causer, and therefore has no Actor factors. It follows that the experiencer argument is the Actor because it has the Actor property of consciousness. On the other hand, with an object-experiencer verb such as annoy the stimulus is a causer-stimulus, and the causer property is a higher-ranking Actor property than consciousness, so the causer outranks the experiencer.

**10.4.4 Motion event roles**

In Sections 4.8 and 9.8 I raised the issue of the lean ontology of a logical semantic theory with just entities and propositions as the basic kinds of ‘things’ in the universe of discourse – in particular, there is no direct way to represent motion of a theme along a path. Theories of LCS based on Dowty (1979) generally analyse only motion to a goal, which can be expressed with BECOME + be-at, as in (52b) or (52c):

(52) a. Jones ran to the beach.
   b. DO (j, [do(j, [run(j)])] CAUSE [BECOME [be-at(j, the beach)]]]) or
   c. DO (j, [do(j, [run(j)])] & [BECOME [be-at(j, the beach)]]])

Levin (2000: 418) and Van Valin and LaPolla (1997: 101, 109) argue that motion predicates like run to the beach are not causative predicates, and so (52b) is incorrect. To replace CAUSE in sentences like these, Van Valin & LaPolla propose two connectives for conjunction, & to mean ‘and subsequently’ and ∧ to mean ‘and simultaneously’ – their analysis for run to the beach is (52c): that is, Jones ran and subsequently came to be at the beach.

One possible advantage of the analysis in (52c) is that it preserves the generalization that the theme is defined as y in BECOME [ predicate(y)], for both themes of motion and themes of change of state. However, the analysis cannot be easily extended to motion along a path that does not have a stated goal, such as run along the river bank. An analysis using BECOME would be something like (53b), but the predicate further-along-the-river-bank would need to be analysed in more detail, and is very complex.

(53) a. Jones ran along the river bank.
b. DO (j, [do(j, [run(j)])] ∧ [BECOME [be-at(j, further-along-the river-bank)]])

'Jones ran and while he ran he became further-along-the-river-bank'

For theories that intend to analyse aspectual predicate classes in LCS as well as thematic relations, the difference between the connectives & and ∧ is crucial. *Run to the beach* is telic (see Section 8.1): that is, it denotes an event with a specified finishing point. *Run along the river bank* is atelic, and denotes an event with no specified finishing point. The general schemata in (54) below show the difference between telic and atelic predicates partly in terms of the time relations between the running and the becoming. In the telic event, the becoming follows the running (& means ‘and subsequently’), while in the atelic event the running and the becoming happen at the same time ( ∧ means ‘and simultaneously’).

\[
\begin{align*}
(54) & \quad \text{a. } [\text{do}(x)] \& [\text{BECOME } [\text{be-at} (x, y)]] & \text{run to the beach, telic} \\
 & \quad \text{b. } [\text{do}(x)] \land [\text{BECOME } [\text{be-at} (x, y)]] & \text{run along the river bank, atelic}
\end{align*}
\]

The time relations among parts of the event are also important for analysing motion events with complex paths, as in (55):

(55) Jones ran from the cottage to the beach.

DO (j, [BECOME [¬ be-at(j, the cottage)])] & do(j, [run(j)]) & BECOME [be-at(j, the beach)])

'Jones did this: he became not at the cottage and then he ran and then he became at the beach'

Here we see that source, as expected, is analysed as the converse of goal:

(56) source = z in BECOME [¬ be-at(y, z)]

Analysing motion events in terms of BECOME does not directly represent the path argument, nor does it easily provide a generalization over the different kinds of path. Given that motion verbs like *run* take all kinds of path indiscriminately, there is an important generalization missing in this approach. For example, the lexical entry for verbs like *run* would have to account for the variety of path types in (57):

\[
\begin{align*}
(57) & \quad \text{a. } \text{do}(x, [\text{run}(x)]) \& \text{BECOME } [\text{be-at}(x, z)] & \text{run to a goal} \\
 & \quad \text{b. } \text{do}(x, [\text{run}(x)]) \land \text{BECOME } [\text{be-at}(x, \text{further-z})] & \text{run along a path} \\
 & \quad \text{c. } \text{BECOME } [\neg \text{be-at}(x, z)] \& \text{do}(x, [\text{run}(x)]) & \text{run from a start-point} \\
 & \quad \text{d. } \text{do}(x, [\text{run}(x)]) \land \text{BECOME } [\text{be-at}(x, \text{further-z})] & \text{run further away from}
\end{align*}
\]
An alternative (see also Section 2.3.3) is to allow a richer range of types of ‘thing’ in the universe of discourse, including such types as paths and places. Jackendoff’s theory of conceptual structures provides a detailed analysis of paths, and the category of path was also included in the lexical decompositional analyses of Miller and Johnson-Laird (1976: 407). In both analyses, spatial prepositions can be several ways ambiguous, including 2-place predicates (e.g., Toby is beside Possum BESIDE(t, p)), path functions and place functions. A path or place function combines with an argument to form a path or place: for example, along(the river bank); from(the cottage), in(the box). A place or path is able to be an argument to a predicate (that is, it is saturated: see Section 4.2). A place argument is typically the second argument of be-at, as in (58a). A path argument is the argument of a verb of motion, as in (58b).

(58) a. Judy is in the study. \(\text{be-at}(j, \text{in}(\text{the study}))\)
    b. Judy ran along the path. \(\text{do}(j, \text{[run}(j, \text{along}(\text{the path}))])\)

The analysis of motion using paths allows a general representation for a verb which takes a path argument, as in (59a). The symbol \(F_{\text{path}}\) stands for path functions such as along or into. But note also that a consequence of this approach is that the COS theme and the theme of motion have different definitions, as in (59b, c):

(59) a. \(\text{run do}(x, \text{[run}(x, (F_{\text{path}}(z))])\)
    b. theme of motion = x in \(\text{predicate}(x, (F_{\text{path}}(y)))\)
    c. theme of change of state = y in \(\text{BECOME}[\text{predicate}(y)]\)

To sum up –

Different assumptions about the ontology of semantic theory are incompatible, and so there is no generalization across different ways to analyse motion and paths or their associated thematic roles. Both approaches have advantages and disadvantages – I shall use the path analysis in following discussion. Possible analyses for roles of the event tier are summarized in (60):

(60)

<table>
<thead>
<tr>
<th></th>
<th>lean ontology</th>
<th>rich ontology</th>
</tr>
</thead>
<tbody>
<tr>
<td>motion theme</td>
<td>y in BECOME[predicate(y)]</td>
<td>y in predicate(y, (F_{path}(z)))</td>
</tr>
<tr>
<td>COS theme</td>
<td>y in BECOME[predicate(y)]</td>
<td>y in BECOME[predicate(y)]</td>
</tr>
<tr>
<td>theme of location</td>
<td>y in \text{be-at}(y, z)</td>
<td>y in \text{be-at}(y, z)</td>
</tr>
<tr>
<td>goal</td>
<td>z in BECOME [\text{be-at}(y, z)]</td>
<td>z in predicate(x, F_{path}(at(z)))</td>
</tr>
<tr>
<td>source</td>
<td>z in BECOME [\sim \text{be-at}(y, z)]</td>
<td>z in predicate(x, from(F_{place}(z)))</td>
</tr>
<tr>
<td>path</td>
<td>–</td>
<td>F_{path}(z)</td>
</tr>
</tbody>
</table>
10.4.5 Recipient and benefactive

Now that we are analysing the meanings of verbs and thematic relations in more detail, we can reconsider the puzzle of recipients and benefactives, starting with recipients as illustrated in (61):

(61) a. Jones gave the bone to the puppy. \(\text{to variant}\)
    b. Jones gave the puppy a bone. \(\text{double object variant}\)

The chief puzzle here is that the alternation does not appear to correlate with any difference in meaning, unlike the \(\text{spray/load}\) alternation and other alternations. With the \(\text{spray/load}\) alternation we saw that the difference in meaning was consistent with the two different argument projections, and therefore consistent with the principle of UA. But with verbs like \(\text{give}\) that show the \textbf{double object alternation}, there does not appear to be a meaning difference to explain the two ways of expressing the arguments. This matter has been much debated without a consistent resolution. I shall outline an analysis for \(\text{give}\) which claims a meaning difference between the two variants, but this analysis does not extend to all verbs with the same alternation.

Hale and Keyser (2002) argue that the key to the difference is shown in examples like (62). (The background is that Norman Mailer wrote a book which was largely about Nixon, and critical of him (Norman Mailer (1968). \textit{Miami and the Siege of Chicago: An informal history of the American political conventions of 1968}. Harmondsworth, Middlesex: Penguin Books.)


Hale and Keyser observe that only the double object variant in (62b) can be used to describe the interpretation that Mailer had a great topic for a book because of Nixon’s personality and role in politics at the time. The \(\text{to}\) variant in (62a), on the other hand, can only be interpreted in the sense that Nixon performed the giving and the book went from Nixon’s possession to Mailer’s possession.

The difference is also illustrated in contrasts like those in (63)–64). The main point to note is that if there is no transfer of possession the \(\text{to}\) variant is anomalous.

(63) a. The weather gave us an excuse (to be late).
    b. \#The weather gave an excuse to us (to be late).

(64) a. Lupe gave an idea for a costume to Felicia.
    (Lupe had the idea and passed it on.)
    b. \#The cultural festival gave an idea for a costume to Felicia.
    c. The cultural festival gave Felicia an idea for a costume.

Broadly, \(\text{give}\) with the double object construction means something like ‘x cause y to have z’, while \(\text{give}\) in the \(\text{to}\) variant means something like ‘x cause y
to pass from x’s possession to y’s possession’. The variant of the verb which takes
the double object construction is analysed in (65):

\[(65) \quad \text{a. Jones gave the puppy a bone.} \]
\[\text{b. } j \ \text{CAUSE } \text{have(}\text{the puppy, a bone}\text{)} \]
\[\text{c. LCS give: } x \ \text{CAUSE } \text{have(}y, z\text{)} \]

In the to variant the subject argument is evidently an agent, and is also a
source. The theme goes from the giver’s possession to the recipient’s possess-
so this variant of give is a kind of metaphorical motion verb or verb of
transfer. Accordingly Jones gave a bone to the puppy can be analysed in terms of
BECOME + be-at (lean ontology) as in (66), or go + path (rich ontology) as
in (67). In (67) I have introduced the function $F_{\text{poss}}$ to form the metaphorical
‘places’ of ‘in Jones’ possession’ and ‘in the puppy’s possession’.

\[(66) \quad \text{Jones gave a bone to the puppy: BECOME be-at version} \]
\[\text{a. } \text{DO}(j, [j \ \text{CAUSE } \text{BECOME [be-at(}\text{a bone, } F_{\text{poss}(\text{the puppy})}\text{)}] } \wedge \]
\[\text{BECOME [} \sim \text{be-at(}\text{a bone, } F_{\text{poss}(\text{j})}\text{)]})] \]
\[\text{b. LCS give: DO}(x, [x \ \text{CAUSE } \text{BECOME [be-at(}y, F_{\text{poss}(z)}\text{)] } \wedge \]
\[\text{BECOME [} \sim \text{be-at(}y, F_{\text{poss}(x)}\text{)]})] \]

\[(67) \quad \text{Jones gave a bone to the puppy: go + path version} \]
\[\text{a. } \text{DO}(j, [j \ \text{CAUSE } \text{go(}\text{a bone, to(}\text{F}_{\text{poss}}(\text{the puppy})\text{)}) } \wedge \text{go(}\text{a bone, from(}F_{\text{poss}}(\text{j})\text{)})]) \]
\[\text{b. LCS give: DO}(x, [x \ \text{CAUSE } \text{go(}y, \text{to(}F_{\text{poss}}(z)) \wedge \text{go(}y, \text{from(}F_{\text{poss}}(x))\text{)})]) \]

Given the different analyses for the to variant and the double object variant,
the roles assigned to the ‘receiver’ argument can be differentiated. The receiver
argument in the to variant is a goal, because it is y in CAUSE [BECOME
[be-at(y, F_{\text{poss}(z))}]], where $F_{\text{poss}}$ is a metaphorical place function. The receiver
in the double object variant is y in BECOME [have(y, z)], and this defines the
recipient role.

\[(68) \quad \text{a. goal } = y \text{ in } \text{BECOME [be-at(}y, F_{\text{poss}(z)}\text{)]} \]
\[\text{or } \text{go(}y, \text{to(}F_{\text{poss}}(z))\text{)} \]
\[\text{b. recipient } = y \text{ in } \text{BECOME [have(}y, z\text{)]} \]

Now we turn to the benefactive theta role. Recall that the benefactive is the
intended recipient, as in (69):

\[(69) \quad \text{a. Nellie built a useful garden shed [for James].} \]
\[\text{b. Nellie built [James] a useful garden shed.} \]

The benefactive role presents a unique problem for the approach we are using
here in which theta roles are assigned by lexical predicates. The benefactive role
is always optionally expressed and is never an entailed part of the meaning of
the verb, so it appears to be an adjunct, rather than an argument. The for variant can be analysed easily enough: the theta role is assigned by (one sense of) the preposition for (just as the instrument role is assigned by the preposition with). Here I shall adapt a proposal from Jackendoff that the function FOR embeds clauses of purpose, as illustrated in (70).

\[(70)\]
\[a.\] LCS for: FOR \[\ldots\] ‘for the purpose of’
\[b.\] benefactive = y in FOR [have(y, z)]
\[c.\] Nellie built a shed for James.
\[d.\] DO(n, [do(n, [build(n, y)])] FOR [have(j, y)] \∧ shed(y))

However, the other form of the benefactive is not marked by any preposition, and appears to be assigned by the double object construction itself, rather than by any lexical predicate, so it isn’t plausibly associated with any LCS.

10.4.6 Summary of theta roles in LCS

- agent = x in DO(x, \[\ldots\])
- causer = x in x CAUSE \[\ldots\]
- non-agentive, non-causative Actor = x in do(x, \[\ldots\])
- causer-stimulus = x in x CAUSE [BECOME [feel(y, predicate)]]
- experiencer (emotion) = y in feel(y, predicate)
- subject-experiencer = x in know(x, y); want(x, y); consider(x, y); love(x, y), etc.
- theme of motion = y in predicate(y, F_{path}(z)) or BECOME [be-at(y, z)]
- theme of change of state = y in BECOME [predicate(y)]
- theme of location = y in be-at(y, z)
- goal = z in predicate(y, (F_{path}(at(z)))) including go(y, to(F_{pos}(z)))) or BECOME [be-at(y, z)] including BECOME [be-at(y, F_{pos}(z))]
- source = z in predicate(x, from(F_{place}(z))) or BECOME [\sim be-at(y, z)]
- recipient = y in BECOME [have(y, z)]
- benefactive = y in FOR [have(y, z)]

where FOR = ‘for the purpose’

10.5 Verb classes and LCS

We have seen that lexical decomposition provides general definitions for theta roles, so far considered individually. We can also use LCS to explore verb classes – that is, groups of verbs which share an argument structure and therefore share the sentence form which expresses that argument structure. For
example, one verb class is the PUT class, already encountered in the discussion of the spray/load alternation, and illustrated in (71). The LCS which characterizes the verb class is in (71e).

(71)  a. Sally put the hat on the bed.
    b. Hermione set the pot on the shelf.
    c. Derek stood the shotgun in the corner.
    d. Hank positioned the widget on the spindle.
    e. LCS PUT class: x CAUSE [BECOME [be-at(y, Fplace(z))]]

The notion of verb classes is used in (at least) two different ways by different authors, which I illustrate here using the spray/load alternation we saw in Section 10.3, Examples (33)–(39), and also shown in (72):

(72)  a. Iris crammed the papers in the bag. PUT variant
    b. Iris crammed the bag with papers. with variant

Linguists often refer to ‘the spray/load verbs’ meaning verbs which show the alternation, including splash, smear, sprinkle, hang, heap, and so on. This terminology identifies the classified verb as a cluster of related meanings and argument structures associated with a particular word-form. Another way of identifying verb classes is to identify the classified verb as one particular sense with one particular argument structure, so the PUT variant of cram and the with variant of cram would be members of different classes. On this use of the term, a verb class has a single LCS and argument structure, and an argument alternation demonstrates that a verb is polysemous between (at least) two classes. I will use the ‘single sense’ notion of verb class.

Many common verbs show clustered patterns of polysemy, or alternations, which are partly predictable from their general meaning, but not entirely. The causative/inchoative alternation (inchoative means ‘beginning or becoming’) is shown in (73):

(73)  causative / inchoative alternation
    a. The solution boiled. inchoative boil
    b. Alex boiled the solution. causative boil
    c. also bend, abate, degrade, shrink, topple, drop, cool, blacken, intensify, ...

The causative/inchoative alternation is found with change-of-state verbs which describe a change that can be brought about by an external influence. For example, the English verb break has several related meanings, only some of which alternate. It is possible to cause a pot to break so we have the alternation The pot broke / Leia broke the pot. But the breaking of a wave is just part of the nature of a wave, and not particularly caused by anything, so this sense of break does not alternate: The wave broke / * The wind broke the wave.

The material/product alternation is shown in (74). The variant in (74a) expresses its arguments in the same way as the verbs transform or turn: Fred
transformed the stick into a whistle; Fred turned the stick into a whistle. The variant in (74b) has the same frame as make or create: Fred made / created a whistle from the stick. Many verbs of manner of making show this alternation.

(74) material/product alternation

a. Fred carved the stick into a whistle. TRANSFORM
b. Fred carved a whistle from the stick. CREATE
c. also build, carve, fashion, make, knit, shape, weave, ...

The locative preposition drop alternation in (75) shows a different form of the holism effect associated with the direct object position. The variant with the preposition may or may not express the total involvement of the location. For example, Wim and Kees skated in the canals (or did canal-skating) in (75a). In comparison, the direct object variant in (75b) suggests that Wim and Kees skated the length of all the canals, although this effect is weaker than an entailment. This alternation occurs with a number of verbs of manner of travel.

(75) locative preposition drop alternation

a. Wim and Kees skated along the canals.
b. Wim and Kees skated the canals.
c. also climb (up) the mountain, cross (over) the paddock, travel (around) the region, ...
In (76d) *The chimney smokes* (cf. also *the smoking remains of the barn*, or metaphorically *The river smoked in the chilly dawn light*), the verb *smoke* means ‘to emit smoke’. This sense can be compared to what I shall call the EMIT verbs, including particularly verbs of bodily emission such as *bleed, spit, vomit, sweat*, and others that will come to mind.

Finally, (76e) *smoke in* *He smoked the fish fillets* expresses a change of state in the fish brought about by the application of smoke, and is similar in structure to *load the wagon with hay*, where the wagon undergoes a change of state through the application or putting on of hay.

Although some of the meanings of *smoke* belong to minor classes with few members, nevertheless they follow recognizable patterns of general meaning correlated with argument structure. Possible analyses for four of the senses of *smoke* are sketched in (77)–(80). I have used the hyphenated notation *ingest-smoke, ingest-drink* to indicate that *smoke* and *drink* in these instances are members of the INGEST class.

(77) a. He smokes a herbal mixture.
   b. LCS *smoke*: do(x, [ingest-smoke(x, y)])
   c. compare: He drinks black coffee / strawberry milk shake.
   d. LCS *drink*: do(x, [ingest-drink(x, y)])

(78) a. He smokes.
   b. LCS *smoke*: do(x, [ingest-smoke(x, y)]) ∧ *tobacco*(y)
   c. compare: He drinks (alcohol); He inhaled (air, or in a culture-specific context, marijuana).
   d. LCS *drink*: do(x, [ingest-drink(x, y)]) ∧ *alcohol*(y)

(79) a. The chimney smokes.
   b. LCS *smoke*: do(x, [emit(x, y)]) ∧ *smoke*(y)
   c. compare: Jones sweated.
   d. LCS *sweat*: do(x, [emit(x, y)]) ∧ *sweat*(y)

(80) a. He smoked the fish fillets.
   b. LCS *smoke*: x CAUSE [BECOME (smoked(x))] BY MEANS OF [x CAUSE [BECOME [be-at(y, z)]]] ∧ *smoke*(y)
   c. compare: He loaded the truck (with y).
   d. LCS *load*: x CAUSE [BECOME [loaded(x)]] BY MEANS OF [x CAUSE [BECOME [be-at(y, z)]]]}

For the final sense of *smoke* as in *Jones smokes a pipe* the LCS should contain both clauses ‘Jones uses a pipe’ and Jones ingests tobacco’. Following Rappaport and Levin’s analysis of the *spray/load* alternation, we will assume that the main clause determines the argument structure of the verb. The argument structure of ‘Jones uses a pipe’ projects in *Jones smokes a pipe*, so the use clause is the main clause in LCS. With this relationship the BY MEANS OF operator is not the appropriate operator, as it would produce the anomalous interpretation ‘Jones used a pipe by means of ingesting tobacco’. Here we need the FOR operator
(see also (72) above) which is the converse of BY MEANS OF, giving the interpretation ‘Jones used a pipe for smoking tobacco’.

(81)  

a. He smokes a pipe.

b. LCS smoke: do(x, [use(x, y)]) FOR [ingest-smoke (x, z) & tobacco(z)]

c. cf. He plays an old flageolet.

d. LCS play: do(x, [use(x, y)]) FOR [make music (x)]

10.6 Closing comment

The discussion of LCS here has focused on the representation of thematic roles and argument structure – that is, on issues of the interface between semantics and syntax. It will be clear to any reader that these kinds of representations do not give a full definition of the sense of the verb and have very little descriptive content in comparison to, for example, Guerssel and colleagues’ definition for cut ‘x produce separation in material integrity of y by sharp edge coming into contact with y’. A question that arises is whether or not lexical entries should be elaborated, building in more descriptive content around the argument-structure-centred LCS that has already been developed.

There is considerable debate on this issue, and on how much descriptive detail should be added to lexical entries, if any. One persuasive and widely-held view is that the lexicon should only contain specifically linguistic content, and that the finer details of word meaning are stored as concepts in the general knowledge store or mental encyclopaedia. On this view the representations of specifically linguistic meaning in the lexicon could be quite lean, though they probably contain much more information than the kinds of representations introduced here.

Although the idea of lexical decomposition or LCS has been accepted as a component of linguistic theory for many years, much of the discussion in different frameworks has tended to address the same or similar phenomena, such as the spray/load alternation or causative verbs. There are still many kinds of verbs remaining to be explored.

Summary of LCS symbols and definitions with selected examples

**Basic symbols**

| Operators: | DO, BECOME, CAUSE, BY MEANS OF, FOR |
| Connectives: | & ‘and subsequently’ |
| & ‘and simultaneously’ |
| General activity predicate: | do |
| Path function: | Fpath to, from, ... |
| Place function: | Fplace general place function at: others in, on, ... |
Thematic Roles

agent = x in DO(x, [...])
causer = x in x CAUSE [...]
non-agentive, non-causative Actor = x in do(x, [...])
causer-stimulus = x in x CAUSE [BECOME [feel(y, predicate)]]

experiencer (emotion) = y in feel(y, predicate)
subject-experiencer = x in know(x, y); want(x, y); consider (x, y); love(x, y), etc.

theme of motion = y in

theme of change of state = y in BECOME [predicate(y)]
theme of location = y in be-at(y, z)
given = x in be-at(x, z)

source = z in predicate(x, from(Fplace(z)))
recipient = y in BECOME [have(y, z)]
benefactive = y in FOR [have(y, z)]

where FOR = ‘for the purpose’

Illustrations

1. The branch is strong. state
   strong (the branch)

2. The branch swayed. activity
   do (the branch, [sway (the branch)])
   LCS sway: do(x, [sway(x)])

3. The window broke. COS inchoative
   LCS: break: BECOME [broken(y)]

4. Jones broke the window. causative COS
   LCS break: x CAUSE [BECOME [broken(y)]]

5. The clock stood on the mantelpiece. be-at + configuration
   LCS stand: be-at-stand (y, Fplace(z))

6. Lassie lay (‘was lying’) on the bed. LCS lie: be-at-lie (y, Fplace(z))
(7) Lassie lay (‘lay down’) on the bed.  inchoative of be-at + configuration
LCS \textit{lie}: do(x, [BECOME [be-at-lie(x, F_{place}(z))]])

(8) Kerrilee annoys Jones.  object-experiencer verb
LCS \textit{annoy}: x CAUSE [\textit{feel(annoyed)(y)}]

(9) Lassie trotted to the fridge.  manner of motion
LCS \textit{trot}: do(x, [\textit{go-trot}(x, F_{path}(z))])

(10) Jones gave the puppy a bone.  \textit{give} + double object
LCS \textit{give}: x CAUSE [\textit{have}(y, z)]

(11) Jones gave a bone to the puppy.  \textit{give} + to
LCS \textit{give}: DO(x, [x CAUSE [\textit{go}(y, to(F_{poss}(z))) \land \textit{go}(y, from(F_{poss}(x)))]])

(12) Jones planted marigolds in the bed.  \textit{plant}, PUT variant
LCS \textit{plant}: x CAUSE [BECOME [be-at(y, F_{place}(z))]]

(13) Jones planted the bed with marigolds.  \textit{plant}, with variant
LCS \textit{plant}: x CAUSE [BECOME [\textit{planted}(z)] BY MEANS OF [x CAUSE [BECOME [be-at(y, F_{place}(z))]]]]

(14) Barry salted the peanuts.  BUTTER verbs
LCS \textit{salt}: x CAUSE [BECOME [be-at(y, F_{place}(z))]] \land \textit{salt}(y)

(15) Lena watered the cabbages.
LCS \textit{water}: x CAUSE [BECOME [be-at(y, F_{place}(z))]] \land \textit{water}(y)

(16) Jones sweated.  EMIT verbs
LCS \textit{sweat}: do(x, [\textit{emit}(x, y)]) \land \textit{sweat}(y)

(17) He smokes a herbal mixture.  smoke, INGEST
LCS \textit{smoke}: do(x, [\textit{ingest-smoke}(x, y)])

(18) He smokes.  smoke, intransitive
LCS \textit{smoke}: do(x, [\textit{ingest-smoke}(x, y)]) \land \textit{tobacco}(y)

(19) The chimney smokes.  smoke EMIT
LCS \textit{smoke}: do(x, [\textit{emit}(x, y)]) \land \textit{smoke}(y)

(20) He smoked the fish fillets.
LCS \textit{smoke}: x CAUSE [BECOME [\textit{smoked}(z)] BY MEANS OF [x CAUSE [BECOME [be-at(y, z)]]] \land \textit{smoke}(y)]

(21) a. He smokes a pipe.  smoke \textit{USE}
b. LCS \textit{smoke}: do(x, [\textit{use}(x, y)]) FOR [\textit{ingest-smoke} (x, z) \& \textit{tobacco}(z)"
Traditional thematic roles

(1) *
Using the table in (30) for reference, identify the thematic roles for the bracketed expressions in the examples below.

a. [Hilda] slung [the case] [overboard].
b. [In the field] was [a tiny cottage].
c. [The cook] beat [the eggs] [to a froth].
d. [Linda] had seen [something fabulous] in a shop downtown.
e. [Blofeld] stroked [the cat].
g. [The mole] sniffed [the air] happily, and thought [that spring was here at last].
h. [Brown] amused [Victoria].

(2) **
Using the table in (30) for reference, identify the thematic roles for the bracketed expressions in the examples below.

[, British 19-year-olds Jim and Paul] crave [, adventure away from their dead-end jobs]. But the offer of a four-star holiday in Venezuela if [, they] bring [, back] [, a package] soon turns [, into a nightmare].

Manny uses [, his underworld connections] to find [, Fran] [, mysterious employment]. In return [, Bernard and Manny] must educate [, a psychopath].

After [, Jake] learns [, that [, the evil Gorgon sisters] have come back [, to life] and are entrancing [, the school cheerleaders] to do their dirty work], Trixie infiltrates [, the group] to stop them taking over [, the world].

[, Architect George Clarke] is about to teach [, you] [, how to really use space and light]. [, You] could be living [, in your dream home] with a few simple changes.

Lexical Conceptual Structure (LCS)

(3) *
Construct an LCS analysis for the whole sense of each sentence below, and then the LCS for the verb meaning alone. See Section 10.4.6 for examples. (You will need to choose whether to use go + Fpath(z) or BECOME + be-at for motion events, or show both versions.)

a. Leander swam to the shore.
b. The play alarmed Claudius.
c. Bottom delighted Titania.
d. Monica leaped over the wall.
e. Gillian bumped the table.
f. Boris laid the hat on the bed.
g. The wind dried the washing.
Follow the instructions for Exercise 3. (You may decide to introduce a new general predicate make, and there may be a BY MEANS OF clause with use.)

a. The cliff dripped icy water.
b. Icy water dripped from the cliff.
c. Lucinda wove the twigs into a wreath. (into a wreath is obligatory).
d. Lucinda wove a wreath from the twigs. (from the twigs is optional).
e. Selena emailed the news to Luke.
f. Cheryl wiped the spots off the window.

**Verb classes**

The sentences below illustrate that nibble and swallow belong in different verb classes, although they could both be called verbs of eating.

nibble

a. Bugs nibbled the lettuce leaf.
b. #Bugs nibbled the lettuce leaf down.
c. Bugs nibbled at the lettuce leaf.

swallow

d. Benjamin swallowed the pill.
e. Benjamin swallowed the pill down.
f. #Benjamin swallowed at the pill.

Using these examples as a guide, sort the verbs below into verbs like nibble and verbs like swallow. (Some verbs may give mixed results – think carefully about the meaning of the test examples in case a different sense of the verb is involved.)

chew, bolt, gulp, gnaw, swig, munch, sip, slurp, snarf, suck, guzzle, gobble, pick, hoover, lick, wolf

(i) What is the general meaning of each verb class?
(ii) Can you construct an LCS for each verb class? (A general predicate contact may be useful here.)

**The examples below show some of the contexts in which the verbs see, look and watch appear, suggesting three different verb classes.**

see

a. Jake saw Loretta.
b. #Jake saw at Loretta.
c. #It was rude of Jake to see Loretta.
d. #Jake saw towards Loretta.

look

a. #Jake looked Loretta.
b. Jake looked at Loretta.
c. It was rude of Jake to look at Loretta.
d. Jake looked towards Loretta.

watch
a. Jake watched Loretta.
b. #Jake watched at Loretta.
c. It was rude of Jake to watch Loretta.
d. #Jake watched towards Loretta.

(i) Using the examples above as a guide, see if you can sort the verbs below into classes like see, look, and watch.
(ii) What is the general meaning and argument structure (i.e., theta roles) of each class?
(iii) Can you construct an LCS for each class?

peer, gawk, spot, scan, sight, study, glare, eye, glance, observe, peep, stare, examine, glimpse, peek, perceive, goggle, witness, spy, gaze, leer, notice, scrutinize, squint, inspect, survey

(7) **** (recommended for discussion)
The Induced Action Alternation is illustrated in (a) and (b) below. (Other verbs which can take this alternation are canter, drive, fly, gallop, march, run, trot, etc.)

a. The pony jumped over the brook.
b. Viola jumped the pony over the brook.
c. The pony jumped.
d. #Viola jumped the pony.

A potential puzzle for UA (Universal Assignment; see Section 10.3) is that the (b) version appears to have two Actor arguments, Viola and the pony. Ideally, the LCS for the (b) versions of verbs in this alternation should identify Viola as the Actor. A clue to a solution for this problem is shown in the difference between (c) and (d). When the argument corresponding to Viola is present there must be a path phrase.

(i) Try to construct an LCS for the general form in (b) which shows that Viola and the pony are both Actors, but Viola is expressed as the subject. (Hint: See discussion of Rappaport & Levin’s analysis of the spray/load alternation in Section 10.3.)

(8) **** (recommended for discussion)
The verbs of change grow, develop, evolve and hatch can take a goal, a source, or neither, as shown in the examples below.

grow
a. The acorn grew / The oak tree grew.
b. The acorn grew into an oak tree.
c. An oak tree grew from the acorn.

develop
a. The bud developed / The leaf developed.
b. The bud developed into a leaf.
c. A leaf developed from the bud.
evolve
a. The reptiles evolved / Birds evolved.
b. Some reptiles evolved into birds.
c. Birds evolved from reptiles.

hatch
a. The eggs hatched / The larvae hatched.
b. The eggs hatched into larvae.
c. The larvae hatched from the eggs.

Compare these with the verbs alter, change, convert and transform as illustrated below.

alter
a. The lake altered / The marsh altered.
   (Same verb sense? Does it become something else?)
b. The lake altered into a marsh.
c. #A marsh altered from the lake.

change
a. The tadpole changed / The frog changed.
   (Same verb sense? Does it become something else?)
b. The tadpole changed into a frog.
c. #A frog changed from the tadpole.

convert
a. #The ironing board converted / The card table converted.
b. The ironing board converted into a card table.
c. #A card table converted from the ironing board.

transform
a. #The ironing board transformed.
b. The ironing board transformed into a card table.
c. #A card table transformed from the ironing board.

(i) Can you identify a general difference in meaning between the two groups of verbs that might account for the different argument structures (i.e. different requirements for paths)?

Van Valin and LaPolla’s (1997) discussion of lexical decomposition of predicates is mainly in pp. 102—29. This is accessible and recommended.

Levin (1993) gives comprehensive data and clear descriptions of verb classes and argument alternations, with examples for every class and alternation. The discussion of verb classes here is based on Levin’s data and classifications. This book is highly recommended.

Ray Jackendoff’s theory of Conceptual Structural Representations is a theory of mental semantic representations at the interface with language, and addresses many of the same
issues as theories of lexical decomposition. Jackendoff provides detailed and accessible discussion of the analysis of verbs, arguments and modifiers. In particular, Jackendoff (1990) is highly recommended.

Dowty (1991) is a much-cited and influential discussion of Actor and Patient, and also of problems with traditional thematic roles. Jackendoff (1987) introduced the separate status of Actor and Patient alongside the other roles: the terms action tier and event tier are taken from this paper. Both of these papers are advanced but not inaccessible.

A recent comprehensive monograph on the syntactic expression of the arguments of verbs, including a review of theta roles, is Levin and Rappaport Hovav (1991). This is fairly advanced and assumes some background in syntax, but is clearly written and not inaccessible.

For critical discussion of the non-aspectual nature of Dowty’s (1979) aspectual calculus, see Levin (2000).

For a completely different kind of approach to decompositional definition of words, not just verbs, see the work of Anna Wierzbicka, particularly Wierzbicka (1996). Wierzbicka uses English basic words as her analytic elements without logical formalization. Her work is accessible and extremely interesting.
This chapter reviews the notion, introduced by the philosopher Donald Davidson, that sentences with action verbs express reference to events. A wide range of linguistic phenomena can be analysed by appealing to reference to events, quantification over events, modification of events, the inner structure of events, different classes of events, and so on. Davidson’s analysis of action sentences is generally considered to be the starting point for a number of event-based theories.

11.1 Davidson’s analysis of action sentences

Reference to events in the semantics of action sentences was introduced in Davidson’s 1967 paper ‘The Logical Form of Action Sentences’. His argument centres on the treatment of adverbials in examples like (1): the adverbials are slowly, with a knife, in the bathroom and at midnight.

(1) Jones buttered the toast slowly with a knife in the bathroom at midnight.

Recall that in Section 2.3 a distinction was drawn between the arguments of a predicate and adverbials appearing in the same sentence. The distinction was marked for the time being by omitting non-arguments altogether from the representation of atomic propositions, with the proviso that some analysis must be found for adverbials. But as Davidson pointed out, a standard logical analysis of the day would express the adverbials also as arguments to the predicate, so that, for example, slowly, with a knife, in the bathroom and at midnight in (1) would be arguments of the predicate buttered, as in (2). (For clarity I shall leave a lot of expressions such as noun phrases unanalysed in the illustration examples in this discussion.)

(2) BUTTER(j, the toast, slowly, with a knife, in the bathroom, at midnight)
Now we also saw earlier that a predicate has a fixed number of argument places, and it must appear with the right number of arguments to form a well-formed proposition. If the representation in (2) is well-formed, then the predicate BUTTER in (2) has six argument places. Presumably it cannot be the same predicate as the one in (3), which has only two argument places.

(3) Jones buttered the toast.
   BUTTER(j, the toast)

Assume that the predicate in (3) is the most basic version of the meaning of the verb butter. Then when the verb butter appears with adverbials which are to be analysed as arguments, as in (2), we must suppose that the verb stands for a different predicate BUTTER with a different number of argument places. For each different set of arguments the verb butter can appear with, there must be a distinct predicate BUTTER as its meaning with the appropriate argument places to accommodate the arguments in the sentence. The different BUTTER predicates can be marked with primes, as in (4):

(4) a. Jones buttered the toast slowly.  
   BUTTER′(Jones, the toast, slowly)
   b. Jones buttered the toast slowly with a knife.  
   BUTTER″(Jones, the toast, slowly, with a knife)
   c. Jones buttered the toast slowly with a knife in the bathroom.  
   BUTTER‴(Jones, the toast, slowly, with a knife, in the bathroom)
   d. Jones buttered the toast slowly with a knife in the bathroom at midnight.  
   BUTTER⁴(Jones, the toast, slowly, with a knife, in the bathroom, at midnight)

The argument structure in (4d) can be represented generally as in (5):

(5) BUTTER⁴(butterer, butteree, manner, instrument, place, time)

There are several problems with this analysis.

First, a predicate closely selects its arguments – in a sense arguments fill spaces or gaps which are part of the meaning of the predicate. For example, in an act of buttering there must be someone or something which does the buttering and something which gets buttered. But the adverbial expressions are far more loosely connected to the predicate BUTTER. Although every action has to take place at some time and place, and no doubt in some manner, this is true of actions or events in general, and not specifically required of butterings.

Second, an action verb can be modified by a variety of adverbials in different combinations. To account for the possible combinations, this analysis must assume that each action verb is multiply ambiguous, with a distinct predicate for each of the modification contexts the verb can appear in. Presumably modification contexts differ in the kind of adverbials that appear as well as in
number. For example, (6a) below has the arguments (butterer, butteree, manner) and (6b) has the arguments (butterer, butteree, instrument), so again, the two verbs buttered would express different predicates.

(6) a. Jones buttered the toast slowly.
   b. Jones buttered the toast with a knife.

Quite apart from the complexity of greatly increasing the number of predicates, it simply isn't convincing that all the appearances of the form buttered in (4) and (6) are different words. Our intuition is that the same predicate appears in all of them.

Davidson also pointed out that sentences like those in (4) are related by entailments in a way which seems to require that the same predicate appears in all the sentences. A selection of these entailments is shown below.

(7) Jones buttered the toast slowly with a knife in the bathroom at midnight.

The entailments of (7) include (8) and (9):

(8) Jones buttered the toast slowly with a knife in the bathroom.
(9) Jones buttered the toast slowly with a knife at midnight.

In turn, (8) entails (10) and (11):

(10) Jones buttered the toast slowly with a knife.
(11) Jones buttered the toast slowly in the bathroom.

And (10) entails (12), (13) and (14):

(12) Jones buttered the toast slowly.
(13) Jones buttered the toast with a knife.
(14) Jones buttered the toast.

Davidson observed that every entailment of this kind resembles entailments which 'drop conjuncts', as in (15):

(15) p&q entails p
   p&q&r entails q&r

Accordingly, Davidson proposed that the entailment in (16a) is the same form of entailment as (16b).

(16) a. ‘Jones buttered the toast with a knife’ entails ‘Jones buttered the toast’.
    b. ‘Donna had icecream and Laura had a Coke’ entails ‘Laura had a Coke’.
There are two main points to this view. First, part of the entailing sentence is identical to the entailed sentence, as indicated in (17):

(17)  a. ‘Donna had icecream and Laura had a Coke’
     entails
     ‘Laura had a Coke’

     b. ‘Jones buttered the toast with a knife’
     entails
     ‘Jones buttered the toast’

Second, the parts of the entailing sentence which are dropped to produce the entailed sentence should be represented as logical conjuncts. This is straightforward for (17a), as shown in (18):

(18) ‘Donna had icecream & Laura had a Coke’
     entails
     ‘Laura had a Coke’
     p&q entails q

Neither of these points can be included in the analysis that treats adverbials as arguments of the verb. For one thing, the adverbial is not contained as a separate conjunct which can be dropped, because it appears as an argument to the verb. Secondly, according to the adverbials-as-arguments analysis, the verb buttered in (19a) below is not the same as the verb buttered in (19b), because they don’t have the same argument structure, so the underlined sequences cannot actually be identical.

(19)  a. Jones buttered the toast.
     b. Jones buttered the toast with a knife.

If the verbs butter in (19) are not the same verb, then the entailment from (19b) to (19a) must depend on a lexical entailment relationship between the two different verbs. That is, under the adverbials-as-arguments analysis the entailment in (20a) below is a lexical entailment, like the entailment between kill and die in (20b), and not a formal entailment like (20c) as Davidson claimed.

(20)  a. ‘Jones buttered the toast with a knife’ entails ‘Jones buttered the toast’.
     b. ‘Jones killed Smith’ entails ‘Smith died’.
     c. ‘Tina screamed and strutted’ entails ‘Tina strutted’.

To replace the adverbials-as-arguments analysis, Davidson proposed that adverbials should be expressed as part of propositions conjoined to the central basic proposition, along the lines of (21):

(21) Jones buttered the toast slowly with a knife.
     BUTTER(Jones, the toast) & p & q
p expresses ‘slowly’
q expresses ‘with a knife’

The next step is to identify the propositions p and q which correspond to the adverbials. Davidson solved this problem by introducing reference to events into the representations for action sentences. A very simple kind of reference to events is the pronoun reference illustrated in (22):

(22) a. Sally threatened Marcia.
   Oh that’s nothing – she’s always shooting her mouth off.
   No – this was with a knife.

b. Jones buttered the toast – I think it was in the bathroom.

The underlined parts of these examples are sentences expressing simple propositions of the forms ‘x was with a knife’ and ‘x was in the bathroom’. The subject pronoun this or it refers back to some entity which has already been mentioned. Davidson argued that this entity is an action or event, and the previous reference to the action or event is in the simple sentence reporting its occurrence, in this case Sally threatened Marcia and Jones buttered the toast. The expressions with a knife and in the bathroom are predicates on the aforementioned events.

Davidson proposed that the event itself is one of the arguments of the action verb, in addition to the arguments we have identified so far, as illustrated in (23):

(23) a. Jones buttered the toast slowly with a knife in the bathroom at midnight.
   b. \( \exists e (\text{BUTTER}(\text{Jones}, \text{the toast}, e) \land \text{SLOWLY}(e) \land \text{WITH}(e, \text{a knife}) \land \text{IN}(e, \text{the bathroom}) \land \text{AT}(e, \text{midnight})) \)
   c. ‘There was an event, which was a buttering of the toast by Jones, and the event was slowly, and the event was with a knife, and the event was in the bathroom and the event was at midnight’

The variable e is a restricted variable ranging over events, just as variables t range over times and variables w range over worlds. The event variable is existentially bound. The first conjunct is the atomic proposition containing the predicate from the main verb, the traditional arguments (that is, the butterer and the butteree) and the event as argument. The adverbials are expressed in separate conjuncts exactly parallel to the sentences in (22) above, This was with a knife and It was in the bathroom.

Now the entailments discussed above take the general form of \( p \land q \) entails q as shown below, where (24) entails both (25) and (26):

(24) Jones buttered the toast slowly with a knife.
    \( \exists e (\text{BUTTER}(\text{Jones}, \text{the toast}, e) \land \text{SLOWLY}(e) \land \text{WITH}(e, \text{a knife})) \)

(25) Jones buttered the toast slowly.
    \( \exists e (\text{BUTTER}(\text{Jones}, \text{the toast}, e) \land \text{SLOWLY}(e)) \)
(26) Jones buttered the toast with a knife.
∃e(BUTTER(Jones, the toast, e) & WITH(e, a knife))

In summary, Davidson argued that an action sentence contains reference to an event. The event itself is an argument of the verbal predicate in the underlying logical form of the sentence, along with the traditionally recognized arguments, which are still arguments of the verb. Adverbials such as time, manner and place are predicates on the event. Each adverbial predication is expressed in logical form as a separate conjunct. The presence or absence of adverbial expressions has no effect on the argument places of the verbal predicate. Consequently, there is no need to adopt the notion that action verbs are multiply ambiguous, each corresponding to many distinct semantic predicates, such as the verb butter corresponding to the predicates BUTTER, BUTTER', BUTTER'', and so on.

11.2 Neodavidsonian developments

When Davidson’s analysis was first presented it was quickly seen that his arguments concerning the nature of entailments applied more widely. Davidson argued that adverbials modifying events should be expressed in separate conjuncts in logical form to capture the conjunct-dropping entailments. Similar examples showed that the traditional arguments of the verb, particularly the subject and object of an action sentence, can also be involved in conjunct-dropping entailments, and therefore should also be expressed in separate conjuncts. This move to the so-called Neodavidsonian analysis makes quite radical changes to Davidson’s original proposal.

11.2.1 Separation of direct arguments

One of the central motivations in Davidson’s analysis is to establish the entailments noted above as instances of conjunct-dropping. Adverbials can almost always be dropped in this way. Apart from introducing the event variable, Davidson retained the traditional arguments of the verb, such as the subject and object, as arguments of the basic predicate, as in (27):

(27) Jones buttered the toast.
    BUTTER(j, the toast, e)

Now the proposition ‘Jones buttered the toast’ also entails the two separate propositions ‘Jones did some buttering’ and ‘The toast got buttered’. Both of these entailments seem to be of the conjunct-dropping kind, just like the entailments which support the separation of adverbials. In Davidson’s representation these propositions cannot be isolated as separate conjuncts, and accordingly they cannot be represented structurally as separate entailments.
This point was made by Hector-Neri Castañeda with the examples in (28):

(28) a. I flew my spaceship to the Morning Star.
    b. I flew to the Morning Star.
    c. My spaceship was flown to the Morning Star.
    d. I flew.
    e. My spaceship was flown.

Castañeda noted that (28a) entails (28b–e). The entailments to (28b, d) involve dropping the object *my spaceship*, and the entailments to (28c, e) drop the subject *I*. These examples show that smaller entailments of the basic sentence can leave out the subject and the object, so it looks as if the subject and object should also be removed from the argument structure for FLY and expressed in separate conjuncts.

A Neodavidsonian representation for (28a) is shown in (29a), with a Davidsonian representation in (29b) for comparison.

(29) a. **Neodavidsonian**
   \[\exists e (\text{FLY}(e) \land \text{SUBJECT}(I, e) \land \text{OBJECT}(\text{my spaceship}, e) \land \text{TO}(e, \text{the Morning Star}))\]
   ‘There was an event and the event was a flying and I was the subject of the event and my spaceship was the object of the event and the event was to the Morning Star’

b. **Davidsonian**
   \[\exists e (\text{FLY}(I, \text{my spaceship}, e) \land \text{TO}(e, \text{Morning Star}))\]
   ‘There was an event of me flying my spaceship and the event was to the Morning Star’

Given the Neodavidsonian representation in (29a), the entailments in (28) above are as shown in (30). (30a) entails (30b–e), (30b) entails (30d), and (30c) entails (30e).

(30) a. I flew my spaceship to the Morning Star.
   \[\exists e (\text{FLY}(e) \land \text{SUBJECT}(I, e) \land \text{OBJECT}(\text{my spaceship}, e) \land \text{TO}(e, \text{the Morning Star}))\]

b. I flew to the Morning Star.
   \[\exists e (\text{FLY}(e) \land \text{SUBJECT}(I, e) \land \text{TO}(e, \text{the Morning Star}))\]

c. My spaceship was flown to the Morning Star.
   \[\exists e (\text{FLY}(e) \land \text{OBJECT}(\text{my spaceship}, e) \land \text{TO}(e, \text{the Morning Star}))\]

d. I flew.
   \[\exists e (\text{FLY}(e) \land \text{OBJECT}(\text{my spaceship}, e) \land \text{TO}(e, \text{the Morning Star}))\]

e. My spaceship was flown.
   \[\exists e (\text{FLY}(e) \land \text{OBJECT}(\text{my spaceship}, e))\]
11.2.2 Relations to events

In the notations used before this chapter, most of the symbols are directly borrowed from the English words they translate, including predicate symbols such as GIVE, CRAZY and SURGEON. As we have seen, the Neodavidsonian analysis decomposes the content of an action verb into parts which do not correspond with whole words in the sentence to be represented, so we need symbols for all the predicates heading the conjoined atomic propositions.

The adverbials Davidson began with can be treated like noun or adjective predicates, so slowly, for example, can be represented as ‘SLOW(e)’ or ‘SLOWLY(e)’. Prepositional phrase frame adverbials (see Section 10.2.5 for frame adverbials) can be analysed as in (31), using the preposition as the main predicate.

\[(31) \begin{align*}
\text{a. } & \text{IN}(e, \text{the kitchen}) \\
\text{b. } & \text{WITH}(e, \text{a knife}) \\
\text{c. } & \text{AT}(e, \text{midnight})
\end{align*}\]

This leaves the direct arguments of the verb to be dealt with, primarily the subject and object. For convenience and following Castañeda’s examples, these were represented above as ‘SUBJECT(x, e)’ and ‘OBJECT(y, e)’, but there are problems with this. Consider again the examples repeated in (32) below:

\[(32) \begin{align*}
\text{a. } & \text{I flew my spaceship to the Morning Star.} \\
& \exists e (\text{FLY}(e) \land \text{SUBJECT}(I, e) \land \text{OBJECT}(\text{my spaceship}, e) \land \text{TO}(e, \text{the Morning Star})) \\
\text{b. } & \text{My spaceship was flown to the Morning Star.} \\
& \exists e (\text{FLY}(e) \land \text{OBJECT}(\text{my spaceship}, e) \land \text{TO}(e, \text{the Morning Star}))
\end{align*}\]

In (32a) my spaceship is the object of the sentence, and the meaning expressed by this is represented as ‘OBJECT(my spaceship, e)’. This content is part of (32b), which is entailed by (32a). To show the entailment as Davidson proposes, the sequence ‘OBJECT(my spaceship, e)’ must be uniformly represented in both (32a) and (32b). But in fact my spaceship is the subject of (32b), not the object, although it has the OBJECT reading because the sentence is passive.

Subject and object are syntactic terms which name the roles noun phrases play in sentences, as in ‘The noun phrase my spaceship is the subject of the sentence My spaceship was flown’. The labels we need for Neodavidsonian representations name the roles played in events by entities that noun phrases refer to, and SUBJECT and OBJECT are the wrong kind of label for this. A common (but sometimes controversial) alternative is to use the thematic relations or thematic roles from traditional linguistic theory, which were discussed in Section 10.2. I shall assume the roles summarized in (30) in Section 10.2.7: Actor and Patient; agent, causer, theme, source, path, goal, recipient, benefactive, location, experiencer and stimulus (causer-stimulus and target-stimulus).
Thematic roles in Neodavidsonian representations are illustrated in (33) below. Notice the difference between the selected argument which receives the location role in (33c) and the frame locative in (33d).

(33) a. Clive sang a song to Marcia.
    ∃e(SING(e) & AGENT-SOURCE(c, e) & THEME(a song, e) & RECIPIENT (m, e))
    ‘There was an event and the event was a singing and Clive was the agent of the event and a song was the theme of the event and Marcia was the recipient of the event’

b. Sally ran to the shop.
    ∃e(RUN(e) & AGENT-THEME(s, e) & GOAL(the shop, e))
    ‘There was an event and the event was a running and Sally was the agent of the event and the shop was the goal of the event’

c. Sally lives in Papatoetoe.
    ∃e(LIVE(e) & THEME(s, e) & LOCATION(p, e))

d. Sally bought a pasta machine in Papatoetoe.
    ∃e(BUY(e) & AGENT(s, e) & THEME(a pasta machine, e) & IN(e, p))

11.2.3 The adicity of verbal predicates

The Neodavidsonian analysis prompts a reconsideration of verbal adicity. Throughout this book we have assumed the traditional and most wide-spread view that the meaning of a verb includes ‘slots’ for its arguments. Davidson’s original analysis retained this view, simply adding the event argument to the already identified arguments. For example, the traditional analysis of give as

\[ \text{GIVE}(x, y, z) \text{ was changed to } \text{GIVE}(x, y, z, e) \text{, but the } x, y \text{ and } z \text{ arguments were retained.} \]

The Neodavidsonian analysis, on the other hand, formally makes a choice possible in what is to be considered the basic content of the verb: (34a) or (34b)? The analysis in (34a) is simply a lexical decomposition equivalent of the traditional analysis, but (34b) expresses the actual meaning of the verb give as a 1-place predicate with the event as its single argument.

(34) a. \( \text{give} = \text{GIVE}(e) \text{ & AGENT}(x, e) \text{ & THEME}(y, e) \text{ & RECIPIENT}(z, e) \)
    b. \( \text{give} = \text{GIVE}(e) \)

Now it is no coincidence that discussions of the traditional view of verbal adicity, that a verb determines the fixed inventory of its arguments, are very commonly illustrated with the verbs give and put. This is because give and put behave as the theory predicts and it is easy to agree on their argument structure. However, as we have already seen (see Sections 2.3 and 10.4.5) the argument structure of most verbs is not so orderly. Common verbs typically have more than one argument structure, corresponding to their membership in more than
one verb class, as shown by argument alternations (e.g., *Jones broke the pot / The pot broke; Gillian spread the crusts with butter / Gillian spread butter on the crusts*). The variability of verb meaning and verbal argument structure calls the traditional view into question, and some scholars, particularly in *Construction Grammar*, propose that syntactic and semantic arguments are determined by the form of the sentence, and not by the meaning of the verb. For example, on this approach the double object construction is analysed as a kind of idiom with associated thematic roles. The verbs which can be inserted into the idiom framework contribute little more than a manner modification, as in (35). The Construction Grammar approach fits well with analysing the verb as a 1-place manner predicate on the event.

(35)  
\[\begin{align*}
\text{a. Jones sent Delia a pet stoat.} \\
\text{b. Double Object Construction = subject} & \quad \text{V} & \quad \text{object}_1 & \quad \text{object}_2 \\
\text{agent} & \quad \text{recipient} & \quad \text{theme} \\
\text{give: ‘in the manner of giving’} \\
\text{send: ‘in the manner of sending’} \\
\text{handed: ‘in the manner of handing’}
\end{align*}\]

I shall continue to assume the more widespread view that verbs have argument structure, but acknowledging that there are persuasive alternatives for forms of verbs in certain constructions.

### 11.3 Events and perception verbs

Reference to events can account for the semantics of what are called *naked infinitive* complements to perception verbs (also called *bare infinitives*), as illustrated in (36) below. The naked infinitives are bracketed.

(36)  
\[\begin{align*}
\text{a. Jones saw [Lina shake the bottle].} \\
\text{b. Jones heard [the gun go off].} \\
\text{c. Jones felt [the floor shake].}
\end{align*}\]

The underlined sequence has the basic structure of a clause, with a subject (*Lina, the gun, the floor*) and a predicate. Without events, traditional logic would analyse such a sequence as a proposition, but this is inappropriate in these contexts. The whole underlined sequence describes what is seen, heard or felt, and a proposition cannot be physically perceived in these ways. Clearly, what is perceived is an event. Representations for (36) are shown in (37):

(37)  
\[\begin{align*}
\text{Jones saw Lina shake the bottle.} \\
\exists e \exists e' (\text{SEE}(e) & \& \text{EXPERIENCER}(j, e) & \& \text{STIMULUS}(e', e) & \& \\
\text{SHAKE}(e') & \& \text{AGENT}(l, e') & \& \text{PATIENT}(\text{the bottle, } e'))
\end{align*}\]

There was an event \(e\) and there was an event \(e'\) and
e is a seeing and
Jones was the experiencer of e and
e′ was the stimulus of e and
e′ was a shaking and
Lina was the agent of e′ and
the bottle was the patient of e′

(38) Jones heard the gun go off.
∃e∃e′(HEAR(e) & EXPERIENCER(j, e) & STIMULUS(e′, e) & GO OFF(e′) & THEME(the gun, e′))
There was an event e and
there was an event e′ and
e was a hearing and
Jones was the experiencer of e and
e′ was the stimulus of e and
e′ was a going off and
the gun was the theme of e′

(39) Jones felt the floor shake.
∃e∃e′(FEEL(e) & EXPERIENCER(j, e) & STIMULUS(e′, e) & SHAKE(e′) & THEME(the floor, e′))
There was an event e and
there was an event e′ and
e was a feeling and
Jones was the experiencer of e and
e′ was the stimulus of e and
e′ was a shaking and
the floor was the theme of e′

Note that these representations are accurate for genuine perceptions, not for hallucinations, because they entail the existence (that is, the real occurrence) of the perceived event. For example, (37) entails (40) below, and similar entailments hold for (38) and (39):

(40) Lina shook the bottle.
∃e′(SHAKE(e′) & AGENT(l, e′) & PATIENT(the bottle, e′))

To recap, the analysis here assumes that Lina shake the bottle in Jones saw Lina shake the bottle is a kind of clause that denotes an event, and the event is the second argument of the perception verb saw.

It has also been observed that the noun phrase after a perception verb in bare infinitive sentences reads like an argument to the verb – for example, Jones saw Lina shake the bottle entails Jones saw Lina. But the representation in (37) does not show this, as it does not show Lina as the stimulus of a seeing event. However, a wider range of cases suggests that the apparent entailment Jones saw Lina shake the bottle entails Jones saw Lina may be a commonsense inference in
the particular case, rather than a general logical entailment of sentences of the same form. The corresponding inferences in (41a–c) below are not obviously true on a normal reading, and (41d) is false.

(41) a. *Jones felt the floor shake* entails *Jones felt the floor*.
    b. *She heard the carpet rustle* entails *She heard the carpet*.
    c. *She saw the wind blow the clouds away* entails *She saw the wind*.
    d. (The intruder was hiding behind the curtain)
        *I saw him twitch the curtain* entails *I saw him*.

11.4 Adding tense and NP quantifiers

For the sake of simplicity, tense has been omitted from Neodavidsonian representations so far, and quantifier NPs have been left as unanalysed expressions in argument positions. When the detail from earlier analyses is included, the relative scope of various expressions needs to be decided.

First, suppose that the existence claim expressed in $\exists e$ is to be taken seriously, and that the way an event exists is that it occurs or takes place. The existence of an event is limited to the time at which it occurs, so that a past event, for example, goes out of existence when it is over, and a future event doesn’t exist until it occurs. In that case, a tense operator always has scope over the existential quantifier binding the event variable, as the existence of the event is confined to the time expressed by the tense, for example:

(42) a. Jones left.
    b. Past $\exists e$ (LEAVE(e) & AGENT(j, e))
        ‘At a past time there was an event and the event was a leaving and Jones was its agent’
    c. $\# \exists e$ Past(LEAVE(e) & AGENT(j, e))
        ‘There is an event which at a past time was a leaving and Jones was its agent’

Following findings in syntactic research which will not be reviewed here, we will assume that in fact the existential quantifier which binds the event variable always has narrow scope. We know that quantifier NPs and tense can interact in scope (see Exercise 2, Chapter 9). Putting these points together yields the following possible orderings.

(43) NP quantifier – tense – $\exists e$
    tense – NP quantifier – $\exists e$

Neodavidsonian representations including tense are illustrated in (44), showing the variable scope of tense and the NP quantifier. Tense operators are used here for simplicity.

(44) a. The president visited Harbin.
b. [The x: PRESIDENT(x)] Past ∃e(VISIT(e) & AGENT(x, e) & PATIENT(h, e))
   ‘For the x, such that x is the president, at a past time there was an event and the event was a visiting and x was the agent of the event and Harbin was the patient of the event’

c. Past [The x: PRESIDENT(x)] ∃e(VISIT(e) & AGENT(x, e) & PATIENT(h, e))
   ‘At a past time, for the x such that x was the president, there was an event and the event was a visiting and x was the agent of the event and Harbin was the patient of the event’

The tense operators can be replaced by the explicit quantifications over times that define the operators. If a representation includes time variables, the relationship between an event and its time of occurrence can be represented by ‘AT(e, t)’, as in (45). (45b) corresponds to (44b). (As in Chapter 9, t* represents the present time.)

\[(45)\]
\[
\begin{align*}
  &\text{a. Jones will leave.} \\
  &\exists t\exists e(t^*<t & (\text{LEAVE}(e) & \text{AGENT}(j, e) & \text{AT}(e, t))) \\
  &\text{b. The president visited Harbin.} \\
  &\text{[The x: PRESIDENT(x)] } \exists t\exists e(t^*<t & \text{VISIT}(e) & \text{AGENT}(x, e) & \text{PATIENT}(h, e) & \text{AT}(e, t))
\end{align*}
\]

---

**EXERCISES**

**Neodavidsonian representations**

(1) *

Give the Neodavidsonian forms, including tense operators, for the following sentences.

a. Marcia quickly shoved Clive into the cupboard.
b. Marcia took the book from Clive.
c. Clive broke some clods up roughly with a shovel.
d. The tree will fall suddenly.
e. Marcia saw Clive punch John.
f. Kennedy’s assassination shocked America.

(Note that *Kennedy’s assassination* is a definite description.)

**Adverbials**

(2) ** (recommended for discussion)

Some adverbials do not seem to be predicates on events. For example, the Neodavidsonian formula for *John lied plausibly* would be
Past ∃e (LIE(e) & AGENT(j, e) & PLAUSIBLE(e))
'There was an event of John's lying and the event was plausible'

but events are not the kind of thing we normally describe as plausible. Plausibility is usually a property of suggestions, assertions, theories and other things like propositions. If we paraphrase the sentence with tell a lie it becomes John told a plausible lie, which suggests that the lie, rather than the event of telling it, should be the thing modified by the adverbial.

In the sentences below, would you analyse the underlined expressions as predicates on the described event? If not, how would you analyse the adverbial?

a. The Bedouin stole silently away.
b. Jones woke up in a foul mood.
c. Horace leaned heavily on the counter.
d. They gathered together in a huddle.
e. Marcia spontaneously combusted.
f. John arrived unexpectedly.
g. Jones was willingly instructed by Clive.
h. Jones was instructed willingly by Clive.
i. Jones woke up in a bar.
j. Anita interviewed Barry over coffee.

Events and thematic roles

(3) ***
Give the Neodavidsonian forms for the sentences below, ensuring that all the entailments listed here are accounted for in your representations:
(a) entails (b)–(e), (c) entails (b) and (d).

a. Brutus stabbed Caesar in the marketplace.
b. Brutus did something.
c. Brutus did something to Caesar.
d. Something happened to Caesar.
e. There was a stabbing in the marketplace.

Which of the entailments among (a)–(e) above can be accounted for using Davidsonian representations?

Further quantification over events

(4) ***
Drawing on your solutions for Exercise (3), give the Neodavidsonian forms for the sentences below. Include tense operators for (c) and (d).

a. Everything John does is crazy.
b. Most of what happens to Marcia is funny.
c. Clive isn't going to do anything for Marcia.
d. Something awful is going to happen.
Does your representation for (c) entail all the following sentences and others like them?

e. Clive isn’t going to buy flowers for Marcia.
f. Clive isn’t going to sharpen a pencil for Marcia.
g. Clive isn’t going to sing for Marcia.

A different kind of scopal ambiguity

(5) ** (recommended for discussion)
Modification by almost in the sentences below is ambiguous. Suppose that almost is an operator ALMOST which takes scope over a proposition, and that its scope might be a complex proposition or any atomic proposition. Using Neodavidsonian forms, how many readings can you represent for the sentences below?

a. Jones almost ran to the store.
b. Jones almost killed Bill.

Perception sentences

(6) *** (recommended for discussion)
Using the Neodavidsonian analysis for perception sentences in Section 11.3, give representations for the sentences below.

a. Zapruder saw Oswald shoot Kennedy.
b. Zapruder saw Kennedy shot by Oswald.

Do the Neodavidsonian representations give the right results here? (Does the rest of the sentence after saw describe the same event in both examples?)

Missing arguments

(7) *** (recommended for discussion)
The underlined verbs in the sentences below have at least one argument (apparently) missing from the sentence. Identify the missing argument(s), and if you can, decide whether or not they are really semantically obligatory.

a. The cakes were eagerly devoured.
b. The boat was sunk to collect the insurance.
c. I gave at the office.
d. She sliced the cheese with a pocket-knife.
e. She sliced the cheese.
f. I gave him a beer and he drank.
g. To know her is to love her.
h. Tom wrote Harry a note.
i. Tom wrote a note.
j. To love is to exalt.
k. To love is to exult.
Much of the discussion in this chapter draws on Parsons (1990) especially Chapters 1–6. This accessible work is the main source on the Neodavidsonian analysis. Chapter 7 of Kenny (1963) discusses the adicity of different kinds of predicate, and whether or not all arguments are really obligatory.


An introduction to Construction Grammar and the view that verbs do not determine their arguments (Section 11.2.3) is in Goldberg (1995).
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