Definitions in Science Lectures

JOHN FLOWERDEW
City Polytechnic of Hong Kong

This paper is an empirical study of the speech act of definition in science lectures. Definitions occurring in sixteen lectures by native speaker biology and chemistry lecturers to non-native speaker students were transcribed and coded onto a computer data base, according to twenty-eight linguistic and para-linguistic features. Data were obtained regarding frequency, distribution, function, and form of definitions. A total of 315 terms were defined, indicating an average frequency of occurrence of one definition per 1 minute 55 seconds. Definitions were found to fulfil one of two main functions: signposting the logical/discourse structure of the subject/lecture, or helping to maintain comprehension as the discourse progresses. Definitions were found to often cluster together in discourse, but there was no evidence of them being more frequent at the beginning of lectures. Definitions were classified into three major types and one minor type, each of the major types being further sub-classified. Findings are reported for ordering of the semantic elements of definitions, syntactic and lexical signalling devices, and various rhetorical and para-linguistic features which accompany definitions. A final section discusses implications for pedagogy.

Writing in 1972, Labov stated:

There is a great deal to do in describing and analysing the patterns of use of language and dialects within specific cultures ... the way in which speakers draw upon the resources of their language to perform certain functions. (Labov 1972:184)

It is now widely recognized that the research programme implied here by Labov has obvious application in the field of language teaching (see, for example, Wolfson 1981; Olshtain and Cohen 1983). Descriptive information on the form, use, distribution, and situational variation of various language functions (speech acts) provides an important source of input for syllabus design. As Olshtain and Cohen (1983:33) put it: 'in order to ... plan the content of a teaching program, we must have a description of the speech-act sets in the target language.' This paper is presented as a further contribution to this research.

Much empirical work to date has focused on a relatively restricted range of speech acts. Requests, apologies, and compliments, for example, have received a great deal of attention. These speech acts are primarily associated with the overall discourse genre of casual conversation. The present study seeks to broaden out this range to take in a speech act more associated with the field of academic discourse—that of definition.
MOTIVATION FOR THE PRESENT STUDY
The present study was motivated by a very specific pedagogic situation. The setting was Sultan Qaboos University, Sultanate of Oman, where undergraduate science students are required to undergo a Foundation Science Course consisting of science lectures, readings, and laboratory practicals, accompanied by English language support courses. Given the low reading level of the Omani students, the reading requirement in the science content course is minimal; the most important medium for understanding English by far is thus the lectures. Observation of these lectures suggested that definition was an important language function for students to comprehend, both in terms of frequency of occurrence and because of its importance within the overall epistemic structure of the lecture medium. In addition, it was clear that content lecturers attached importance to the need for students to be able to comprehend and produce definitions, evidence for this coming from the large number of behavioural objectives expressed in terms of ‘be able to define X, Y, Z, etc.’, and the requirement to ‘define’ in tests and examinations.

A comparison between how lecturers define in lectures and how the language of definition is presented in EAP course books showed up a great discrepancy between these two media. Whilst definitions in lectures, as this study will show, are subject to much variation, the typical EAP course book presentation of definitions tends to be very prescriptive, presenting a formulaic pattern for students to imitate. Allen and Widdowson, for example, provide the following presentation:

**Definitions in scientific discourse**
Definitions in scientific discourse often take the following forms:

(a) A **is/are** may be defined as B which C.

E.g. A thermometer is an instrument which is used for measuring temperatures. A thermometer may be defined as an instrument which is used for measuring temperature.

(b) B which C **is/are called** A

E.g. An instrument which is used for measuring temperatures is called a thermometer. An instrument which is used for measuring temperatures is known as a thermometer. (Allen and Widdowson 1974:17)

This presentation is followed by practice in using the formulae to define various physical phenomena (metamorphosis, metals, etc.).

As Swales has pointed out:

the apparent relationship between a defining function and formal exponence has been much used by materials writers as a way of getting students to produce ‘real’ scientific statements within syntactic constraints. Thus the definition formula can be utilized as a vehicle for strengthening student control of a number of important grammatical features of Scientific English: equative BE, indefinite generalizations, class-word
vocabulary development, prepositional usage, and last but by no means least, the various types of relativization prominent in this register. (Swales undated: 42)

Extensive practice such as that described here by Swales in the production of definitions as a means of teaching grammar serves to further reinforce the identification of definitions in the mind of the learner as following a fixed set of formulae.

Given this mismatch between the formulaic presentation and practice of definitions in EAP course books and the more varied way definitions are actually expressed in lectures, the present study set out to investigate, therefore, exactly how definitions are performed in lectures, with a view to the development of a more appropriate pedagogy for teaching the comprehension of this important language function in lectures.

LITERATURE REVIEW
Definition plays a crucial role in every field of rational enquiry. As such it has been the focus of attention on the part of philosophers since Socrates. It was, indeed, the socratic question 'What does (virtue, justice, etc.) mean?', as the starting point for philosophical discourse, which did most to draw attention to the importance of definitions in rational enquiry. At a more mundane level, the importance of definition has long been recognized by language teachers working within the field of academic discourse. Work on the language of definition is a feature of many EAP course books (see Swales 1981, for early references). This work has been able to draw upon linguistic research by a number of writers, including Lambrou (1979), Darien (1981), Swales (1981), Bramki and Williams (1984), and Trimble (1985).

Most dictionaries and encyclopaedias of philosophy carry an entry on definition. These typically take the form of a discussion of what constitutes a 'good' definition and of the various different types or classes of definition that have been specified by various philosophers. There is general agreement that the format of 'term' (definiens) + 'class' (genus or definiendum) + 'characteristic' (differentia) represents the paradigm form of a definition, other less precise formulations being seen as somehow inadequate. Definitions are thus judged on their completeness, as well as their universality. Edwards cites the rules for definition, first suggested by Aristotle:

1. a definition should give the essence or nature of the thing defined, rather than its accidental properties
2. a definition should give the genus and differentia of the thing defined.
3. one should not define by synonyms
4. a definition should be concise
5. one should not define by metaphors
6. one should not define by negative terms or by correlative terms. (Edwards 1967:322)

In considering these points it is important to note that philosophers typically focus on decontextualized instances of definitions, unlike applied linguists, who deal, or at least should deal, with definitions as they occur in context.
Early applied linguistics work on definition was carried out as part of the University of Washington EST programme during the 1970s. This work is synthesized in Trimble (1985) and references to the individual early papers can be found there. According to Trimble, 'definition' is one of the basic rhetorical functions of EST discourse, the others being 'description' (physical, function, and process), 'classification', and 'instructions'. Trimble approaches definition by establishing a set of categories, or types of definitions. Definitions are either 'simple' (one sentence), or 'complex' (more than one sentence). As complex definitions are usually expansions of formal definitions, they will not be reported on further here. Simple definitions are sub-classified as either 'formal' (i.e. they consist of term + class + characteristic), 'semi-formal' (i.e. the class is omitted), or 'non-formal' (for example, a synonym, a negative statement, or an antonym). Given that the distinction between a formal and semi-formal definition rests upon the presence or absence of a class word, a formal definition normally provides more information than a semi-formal definition. This is not always the case, however. Sometimes there is no point in including a class word because the class is either obvious, or it is so broad as to be meaningless. In other instances, where a class word is included (and the definition thus fits the category 'formal'), the class is merely a repetition of the term, or a referential item such as 'that which', 'those who', 'when', etc., and thus provides no extra information.

Like Trimble, Darien (1981) also takes a taxonomic approach to definitions, but whereas Trimble's criteria for classification are formal, Darien's are semantic. Darien presents a framework of thirteen 'non-exhaustive' and 'non-watertight' semantic properties (the last of which, incidentally, has fourteen subcategories) according to which definitions are classified. Examples of these semantic properties include 'process', 'composition', 'physical properties', 'behavioural characteristics', 'contrast', 'examples', etc. Darien also provides what appears to be a quite exhaustive list of the syntactic features used to realize definitions. Neither Trimble nor Darien, it should be pointed out, however, appears to have based his work on a specified corpus.

In contrast to Trimble and Darien, Lambrou (1979) does have a specified corpus: a selection of undergraduate scientific textbooks. For Lambrou, the major distinguishing feature of categories of definition is the ordering of the elements. Lambrou makes the important point that the term does not always come first in the sequencing of the semantic components of a definition, i.e. the formula 'B which C is called A', with the term coming last, (referred to as 'nominal', or 'naming' definition) is just as possible as the more usual 'A is B which is C' type, with the term coming first (termed 'formal'). These two types form the basis of Lambrou's classification. They are both sub-classified into 'sentential' (taking the form of a sentence), 'subordinated' (in the form of a subordinate clause or clauses) and 'dictionary' (with the definition in grammatical apposition to the term being defined). Lambrou provides data on the relative frequency of his categories.

Swales (1981), after providing a succinct overview of important points made
in the literature on definition, shows how the form of definitions can vary from subject area to subject area (his examples are science and law). Points made by Swales in his overview, and not mentioned so far in this review, are (1) that unlike the decontextualized instances of philosophy, contextualized definitions are not necessarily conceived of as universal axioms, but are very often merely explanations of terms, and (2) that definitions in science are typically discourse-initial.

Like Lambrou, Bramki and Williams (1984) base their work on a specified corpus, but whereas all of the research reported on up until now deals with science, Bramki and Williams's corpus is on economics (the first four chapters of a textbook). Bearing in mind Swales's point about the variation of the form of definitions according to subject area, the likely relevance of the findings of this work is thus reduced. Echoing the point made by Swales reported above, Bramki and Williams note that contextualized definitions provide less precise information than do decontextualized definitions. Accordingly, they prefer the term 'lexical familiarization' for the information given when new terms are introduced in a textbook. Based on the analysis of their corpus, Bramki and Williams divide familiarization devices into six categories (some of which are further subcategorized):

1. exemplification
2. explanation
3. definition
4. stipulation
5. synonymy
6. non-verbal illustration. (Bramki and Williams 1984)

A final piece of research into the structure and function of definitions is that of Chaudron (1982). Chaudron's study was based on humanities content lessons to ESL learners. Chaudron's work is of particular interest to the present study for two reasons. First, it is the only study reported here to focus on spoken definition. Second, it is based on data directed at non-natives. Whereas Chaudron's study has these two features in common with the present research, it differs in being based on humanities, not science. Chaudron does not use the term 'definition', preferring 'elaboration', which he defines as 'terminology or expressions that the teachers in some way defined, qualified, questioned, repeated, paraphrased, exemplified, or expanded upon in the course of their lesson ...' (1982:171). Various devices used in 'elaborations' are exemplified. These fall under the broad headings of 'phonological and prosodic structures', 'morphological structures', 'syntactic structures', discourse structures', 'semantic-cognitive relationships', and 'apposition, parallelism, and paraphrase'. The main thrust of Chaudron's work is to determine characteristics which may be helpful or harmful in the comprehension and acquisition of vocabulary.

RESEARCH QUESTIONS

In approaching the question of spoken definition from an empirical perspective several research questions were pursued:
1. How important is definition, in the undergraduate science lectures that make up the corpus, in terms of frequency of occurrence?
2. What is the distribution of definitions within the discourse of the lectures?
3. What are the different types of definition and what are their distinguishing characteristics?
4. How are definitions signalled linguistically?
5. What particular rhetorical features accompany definitions?
6. What, if any, paralinguistic features are associated with definitions?

METHOD

Corpus

The corpus for the study consists of 329 definitions relating to 315 terms defined, i.e. 14 of the terms were accompanied by more than one definition. The data was transcribed from sixteen lectures given as part of the Foundation Science Course for Omani students in the English-medium Sultan Qaboos University, Sultanate of Oman. To ensure a spread of speakers and topics, eight speakers were selected (four each from chemistry and biology), each speaker providing two lectures. Lecture topics are listed in Appendix 1.

Speakers and audience

The lectures were given by English native speaker professors to non-native speaker (Omani) students. Class size varied from twenty to twenty-five students. Each lecturer had a different class. However, level of proficiency in English and science was likely to have been fairly homogeneous across classes, as all students were enrolled in the same programme and were allocated to classes on an essentially random basis. The level of English proficiency of the student body as a whole, as measured on The Comprehensive English Language Test (CELT) (Harris and Palmer 1986), was found to be below normal for admission to US university degree programs. Although no objective measure is available for assessing level of scientific knowledge, students were generally estimated by their science lecturers to be somewhere between British ‘O’ and ‘A’ level.

Data collection and coding procedure

The lectures were selected at random from a body of video-taped recordings made as a routine part of the science teaching programme. The only constraints on the selection were that there should be two lectures by each lecturer and that biology and chemistry should be equally represented. Definitions occurring in each lecture were transcribed, along with any significant context, onto a computer data base. Each definition was assigned to its own memo file and was then coded according to criteria which were judged to be of potential significance. The approach to the creation of the data-base structure is very similar to that described in Thomas (1986) for the Cross Cultural Speech Act Realization Project. Appendix 2 shows the type of information coded for each definition. Reliability of coding for basic class and sub-class of definition (fields
5-10 in Appendix 2) was checked by having a research assistant code 100 of the definitions in the corpus, selected at random. Inter-rater reliability for the basic classes was 90 per cent and for the sub-classes 87 per cent.

RESULTS
The results are presented as responses to the research questions set out above:

1. How important is definition in terms of frequency of occurrence?
Appendix 3 shows the number of terms defined in each lecture, along with a calculation of the average time lapse between each definition. The data clearly show the importance of definition within the context of the scientific lectures that make up the corpus, with an overall average of one term defined every 1 minute 55 seconds. However, there is considerable variation in rate from lecture to lecture and from speaker to speaker. The lecture with the highest rate of terms defined is ‘Chemicals of life: proteins and vitamins’ (Speaker H), with one term defined every 1 minute 11 seconds. The lowest rate is ‘Measurement and significant figures’ (Speaker B), with one term defined every 4 minutes 23 seconds. The lecturer with the highest variation of rate between lectures is Speaker B (19 seconds). The lecturer with the lowest variation of rate between lectures is Speaker H (1 second). A larger corpus would be required, however, if the statistical significance of such variation were to be considered.

2. What is the distribution of definitions within the discourse of the lectures?
Bramki and Williams (1984), in their paper on lexical familiarization in written text, found familiarization to be more frequent in the early part of their corpus. Echoing a point made by Swales (undated), Bramki and Williams argue that this finding is explained by the fact that it is in the early part of a text that specialist terms are introduced. In the present data, however, there is no evidence of definitions being more predominant at the beginning of lectures. This finding was derived by counting the number of definitions occurring in the first five minutes of each lecture and comparing this with the rate of definitions for the lecture overall. Overall differences were observed to be small. Of course, it is possible that definitions are more frequent at the beginning of a course (as opposed to individual lectures), but given that the lectures which make up the corpus were taken at random, there is no way that this hypothesis can be tested here.

Although there is no evidence of definitions clustering at the beginning of lectures, they are often organized in systematic patterns, as a function of the logical/discourse structure of the subject matter/lecture. In one lecture, for example, where the topic is ‘states of matter’, definitions are provided of the various points when substances change from one state to another—melting point, boiling point, liquefaction point, freezing point, sublimation. In some cases definitions act as signposts which structure the whole, or large sections, of a lecture. This is the case in the lecture, ‘Characteristics of living organisms’, where definitions of the various basic functions of life, such as respiration,
reproduction, locomotion, excretion, form the framework of the overall lecture. In the lecture, ‘Chemicals of life: carbohydrates and lipids’, a large section is organized around definitions of the various types of carbohydrates.

When definitions are grouped in the way described they constitute the main focus of the discourse, often being reinforced by various linguistic and paralinguistic emphasizers. In contrast to these high-focus definitions, the ordering of which is structured according to the logical structure of the subject matter or overall discourse structure of the lecture, there is another type of definition, termed ‘embedded’ definitions, which is low focus. The function of this type is to make sure that the audience understands terms which are introduced as the lecture progresses, but which are not the focal point of the information. These do not occur in any systematic pattern, but are introduced as and when they are needed to maintain comprehension. The following are examples of this type of embedded definition:

... and if you remember I said they were persistent / persistent means that they / for most of the life of the cell / they are there . . .
... several of them will fuse / by fuse I mean join together . . .
... if you look at micro-organisms / which are very small organisms / like bacteria for example . . .

The majority of embedded definitions are of the type which are termed ‘substitutions’ in the classification framework which is set out below, in answer to research question 3.

3. What are the different types of definition and what are their distinguishing characteristics?

The system of classification employed here represents a synthesis of the various taxonomies outlined in the review of the literature above. Appendix 4 represents the classification of definitions employed in this study in systems format.

The classification consists of four basic categories: formal definition, semi-formal definition, substitution, and ostension. With the exception of ostension (a minor category), each type is further sub-classified. These classes and sub-classes are defined and exemplified below.

**Formal definition.** Following Trimble (1985), formal definitions are characterized by their semantic structure of term, class, and distinguishing characteristic(s) (in paradigm form ‘An A is a B which C’). The key feature of a good formal definition is generally taken to be its precision. It might be thought that spoken definitions, produced as they are under the pressures of real time processing, might sacrifice some of the precision associated with the isolated, decontextualized definitions and the definitions occurring in written text, which have been the focus of study to date. However, although spoken definitions are subject to the false starts, hesitation, repetition, repair, etc. associated with
spoken language in general, in terms of their semantic content of term, class, and characteristic, they are remarkably precise:

... a way of defining a metal is by saying that it is an element that readily forms cations ... (term + class + characteristic underlined)
... so nephridiopores are very tiny holes lying on the ventral surface of the earth worm which excrete all the waste products collected by the nephridia ... (term + class + characteristics underlined)

As with written definition, sometimes the class word can be a ‘dummy’—either a repetition of the term or a referential item:

(repetition) ... a middle zero is a zero which has no zero digits on both sides ...
(‘dummy’ underlined)

(reference) ... a quantitative observation is one that tells us how much of something rather than just the kind of object ... (‘dummy’ underlined)

As with written definition, again, the ordering of the semantic elements may be varied, with the term coming last, i.e. nominal definition (Lambrou 1979).

... now a photo that we take through a microscope we call a micrograph / OK ... (term underlined)
... in the muscle tail there are fibres which allow the muscle to contract / contractile fibres ... (term underlined)

Formal definitions can be sub-classified according to the semantic content of the characteristic. All instances of formal definition reviewed in the present corpus fit into one or more of the following four semantic categories:

—behaviour/process/function
... a way of defining a metal is by saying that it is an element that readily forms a cation ...

—composition/structure
... compounds ... are substances / the molecules of which / are made up from ... two or more different elements / two or more different elements ...

—location/occurrence
... remember / I said ultra structure is the fine structure within the cell ...

—attribute/property
... metallic bonding is a non-directional electrostatic attraction / between a lattice of cations / and a surrounding sea of valence electrons ...

Semi-formal definition. Following Trimble, in a semi-formal definition the term is identified by means of the presentation of a key characteristic or characteristics. Whilst the characteristic(s) may well be sufficient to distinguish the term from other members of its class, the class is not mentioned. A semi-formal definition is thus, in general, less precise than a formal definition.

As in formal definitions, semi-formal definitions can be subclassified according to the semantic content of the characteristic, the same categories applying:
behaviour/process/function

... conduction of water and dissolved substances from the tip of the root into the stem / and of course plant food coming back from the leaves down into the root / so that is the vascular function.

composition/structure

... you remember that we said that compounds were made from two or more different elements combined chemically.

location/occurrence

... behind the zone of differentiation we have the permanent tissues / this is where the recognizable tissues have finally been established / permanent tissues.

attribute/property

... this is a fibrous root system / alright / where you have no one root being more important than the others.

In addition, semi-formal definitions may define by referring to examples of the group the term refers to:

... a stable electronic configuration is like the inert gases.

As with formal definitions, again, semi-formal definitions may vary the ordering of the semantic components, with the term coming last (nominal definition):

... so all living organisms were responding to stimuli / this we call responsiveness.

(term underlined)

... the total number of digits plus the one uncertain digit are / these are called the significant figures.

(term underlined)

See also some of the previous examples.

Substitution. In a substitution a word, word-part, phrase, or phrases, with a similar meaning, is substituted for the newly introduced term. There are three types of substitution: synonym, paraphrase, and derivation.

Synonym is defined here as a lexical item (to include such things as phrasal verbs and set phrases) with the same or similar meaning to the item it is paired with:

... fuse / by fuse I mean join together.

Paraphrase is defined as a phrase or phrases, greater than a lexical item, with the same or similar meaning to the item it is paired with:

... electropositive is likes to become positively charged.

... so they're opaque / do you remember that word / you can't see through it / light does not go through.

A derivation is defined as a word, or more often a word part (often from Latin or Greek), cited to explain the derivation and hence the meaning of the term it is a part of or refers to:

... the pyliferous layer is so called because it's hairy / it's a hairy layer.
a structure called the cytopharynx / cyto meaning cell ... and so cytopharynx just means the pharynx of the cell ...

Like the other basic classes of definition, substitutions can occur in nominal form:

... the growing tip / or the apical meristem ...
... now all these are found inside the vascular cylinder / the vascular cylinder is sometimes referred to as the stele ...

The three types of substitution sometimes occur in conjunction with a formal or semi-formal definition, i.e. a term is defined by both a formal or semi-formal definition, and a substitution.

Ostensive definition. This is a very minor class, compared with the three already described. An ostensive definition is performed by indicating some visual stimulus such as an object, a photograph, or a diagram. All of the three basic classes of definition described already are frequently accompanied by some sort of visual support (see the section below on paralinguistic features). However, in a few cases a definition is performed by ostension alone. When this occurs it is counted as an ostensive definition in the present study. If ostension is merely an accompaniment to some sort of verbal definition, then this is counted as visual support and not ostensive definition. The following are examples of ostensive definition:

... these cells are called the chondroblasts ... (pointing)
... now the oral groove is a groove in the animal looking like this ... (pointing)

4. How are definitions signalled linguistically?
Definitions are signalled by a number of frequently occurring linguistic devices, both syntactic and lexical.

Syntactic signalling. In this corpus, the most frequent syntactic form occurring in definitions was the copula (40 per cent), with appositions being considerably less frequent. Two other syntactic features, relative clauses and pre- or post-modification, whose function is to relate the class to the characteristic, appeared to occur only in formal definitions, although quite often in these.

Lexical signalling. Roughly half of the definitions in this corpus contained some form of clear lexical signal. In just under a third of the cases this was the lexical signal we call / is called / are called / called. Somewhat less frequently than this, was mean(s). Other forms such as or, known as, and that is also occurred. Only two instances were observed of use of the performative define(d).

5. What particular rhetorical features accompany definitions?
Two important rhetorical features of definitions have already been mentioned: the ordering of the semantic elements (i.e. (−/+)) nominal definition) and embedding.
As Swales (1981) points out, most writers consider (+) nominal and (−) nominal definitions to be equivalent in function. There does, however, seem to be a difference between the two types, which can be accounted for in terms of the given/new contract (Clark and Clark 1977). In the (−) nominal definition, where the term comes first, the term has usually been established as given information prior to the definition, as in the following examples, where the term is referred to in the sense group preceding the definition:

... golgi bodies do produce other substances / for example / the cuticle (written on board) / the cuticle is the outside / the skin if you like of the insect / that hard outer layer ... in insects ... (term underlined)
... now there's something called a metallic radius / and I haven't actually said what it is / a metallic radius ... (+ definition) (term underlined)

In the (+) nominal definition, however, the term to be defined is new information, whereas the characteristic and class have been already established as given. In the following formal definition, for example, the class, 'hypothesis', and the characteristic, 'which has been tested by many observations', are assumed to already be a part of the listener's established knowledge; the new information is the term, 'theory', which accordingly comes at the end:

... a hypothesis which has been tested by many observations / and which we still believe / is called a theory ...

The choice between (+) nominal or (−) nominal definition is thus determined, at least in part, by the information structure of the ongoing discourse.

Overall, a little over a fifth of definitions in this corpus were 'embedded'. Not surprisingly, substitution occurred most often in an embedded context, definitions requiring emphasis (i.e. not embedded) more likely being expressed in the fuller formal or semi-formal form. Nevertheless, formal and semi-formal definitions did also occur in an embedded context.

Definitions are sometimes accompanied by a 'peripheral utterance', either before, with a 'grounder', or after, with a 'confirmatory utterance'. The function of grounders is to prepare the listener for the definition that is about to be presented. They thus fulfil an important signalling role:

... now there is a rule / it's called an empirical rule ... (+ definition of empirical rule)
... there are different types of carbonium iron / let me show you the different types ... (+ definition of each type)

Confirmatory utterances have a similar role to grounders, except they have a retrospective, as opposed to a prospective, function, emphasizing that the previous utterance was in fact a definition:

(definition of Markonikoff's rule) ... that's Markonikoff's rule, OK / very easy to remember ... /
(definition of an alkene) ... that's an alkene / right / it has double bonds ...
A device related to grounders and confirmatory utterances in its signalling function is the 'rhetorical', or 'elicitation' question. Both rhetorical and elicitation questions have the function again of signalling the impending definition and making it stand out from the discourse as a whole. Whether or not a question is intended to be rhetorical or is genuinely seeking an answer is often hard to say. For this reason these two devices are grouped together in the analysis of the data. The following are examples of rhetorical/elicitation questions:

- ... what are protista ... (+ definition of protista)
- ... now do you remember what I said an organelle was ... (+ definition of organelle)
- ... do you understand the word coagulation ... (+ definition of coagulation)

Some preferred forms for rhetorical/elicitation questions are what/mean ?, do/does anybody/somebody know?, what call/called?, and can anyone/someone tell me?

A whole or part of a definition is often repeated. Again the function of 'repetition' is to give prominence to the definition and to emphasize its importance. Repetition was a frequent feature of definitions in the corpus, appearing about half the time.

Another rhetorical device with a highlighting function is 'left dislocation' (Chafe 1976; Quirk et al. 1985), where a pronoun is placed after the term, in order to establish it as 'old' or 'given' information, so that attention can be focused, in turn, on both the term and the defining information:

- ... the epiblem / that's the outer part of the cortex . . .
- ... the bonding / that's what holds it together . . .

Sometimes a definition may be 'reported', i.e. the speaker reminds the audience of the definition of a term made previously. The function of this device is to reintroduce into the discourse, thereby re-establishing as common ground, information which is important for understanding what the lecturer is dealing with at the present moment:

- ... you remember / we said that compounds were made from two or more different elements combined chemically . . .
- ... remember / we said ultra structures are the fine structures of the cell . . .

A final rhetorical device is that of 'internal modification', where an adverbial is used to modify the force of the definition in various ways:

- ... vesicle just means a small sack with membrane around it . . .
- ... lipids are basically fats and oils . . . so lipids are basically fats and oils . . .

6. **What paralinguistic features are associated with definitions?**

Three very obvious paralinguistic features accompanied definitions frequently in the corpus: 'graphic support (writing up either the term to be defined and/or a whole or part of the rest of the definition); 'visual support' (reference to some
sort of diagram, chart or object in relation to the definition); and 'emphatic stress' (heavy emphasis on the term being defined). The function of these devices in general is to give prominence to the definition in the ongoing discourse.

SUMMARY OF RESULTS
In summary, the results have demonstrated that, based on its frequency of occurrence, definition is an important speech act in the context of undergraduate lectures to non-native speakers in biology and chemistry. Definitions may fulfil one of two functions, either signposting the logical/discourse structure of the subject/lecture, or helping to maintain comprehension as the discourse progresses. Although definitions often cluster together, there is no evidence that they are more frequent at the beginning of lectures. Definitions can be classified into one of three major types (formal, semi-formal, substitution) and one minor type (ostension). Each of the major types can be further sub-classified; according to semantic type, for formal and semi-formal; and according to whether the definition is synonym, paraphrase, or derivation, for substitution. In addition, each of the major types can be classified as (−/+), nominal and (−/+), embedded. Most definitions have some sort of syntactic and/or lexical signalling, the copula being the most important syntactically, and call/called and means the most important lexically. In addition to syntactic and lexical signalling there is a range of rhetorical devices associated with definitions. Amongst the most significant of these are the ordering of the elements of term/class/characteristic, (−/+), embedding, various types of peripheral utterances, and repetition. There are three major types of paralinguistic feature which also help to convey the rhetorical force of definitions: graphic support, other visual support, and emphatic stress.

IMPLICATIONS FOR PEDAGOGY
The introduction to this paper pointed out the value of descriptive work on language functions (speech acts) as input to course design. The results of this study provide a solid framework for teaching the language of spoken definition in science, whether receptively or productively. In particular, the classification system and the syntactic and lexical signalling devices reported on provide potential input to syllabus design.

In spite of this solid framework, the results of this study need to be applied judiciously. As was pointed out in the review of the literature at the beginning of this paper, the characteristics of definitions are likely to vary according to subject matter and audience. As far as the data for this study are concerned the subject matter was that of biology and chemistry and the relationship of speaker and audience was very much that of expert to novice, the audience being composed of relatively low-level students, both in terms of scientific knowledge and proficiency in English. Audiences concerned with domains other than biology and chemistry, and audiences with a different level of expertise in science and/or English may (1) have a lesser or greater overall need to
understand definitions and (2) require familiarity with a lesser or greater range of forms and functions. Only further research could determine to what degree this was the case in other given contexts.

Other researchers (Manes and Wolfson 1981; Olshtain and Cohen 1983) have emphasized the striking, almost formulaic choice of language in the realization of the speech acts they have studied (compliments and apologies, respectively), thereby implying that they are easy for non-native speakers to learn and that they can easily be incorporated into ESL syllabuses. A formulaic approach, as pointed out above in this paper, has also been adopted for the presentation of the language of definition in EAP course books. The data presented in this study, in contrast, seems to suggest a rather rich pattern of variation in the realization of the speech act of definition. Although the system can be reduced to a choice of three basic types (along with one minor one), within each type there is a large range of other choices which can be made, both in formal realization and rhetorical function. Such choices invariably concern the way definitions are woven into the overall fabric of a discourse, producing varying shades of emphasis, focus, and interpersonal meaning.

In order that the learner should be able to comprehend and produce such shades of meaning, an appropriate pedagogy should therefore involve the study of definitions in the context of the discourse in which they occur. Aspects of the results of this study—the basic definition types and their syntactic and lexical signalling—suitably conveyed to the learner, might provide a useful initial heuristic. But this would then need to be applied to the study and production of definitions (along with all their associated rhetorical features) in context—preferably, in order to allow for paralinguistic features, on video. Such an approach would have the added advantage of ensuring that less emphasis was placed on the subject matter- and audience-dependent aspects of the results of this study referred to above.

One appropriate methodology might be one which Candlin (1981) has referred to as ‘metacommunicating’, an approach in which learners are encouraged to explore and discuss various manifestations of aspects of language (in this case definitions) as they occur in context. Another appropriate methodology, and a more radical one, would be a content based language course, where the basis of language work would be the content of the science lectures themselves. Under these conditions learners would be guaranteed exposure to the full range of variation in the performance of definitions. If either of the two above-mentioned methodologies were adopted, the results of this study would serve as a guide to the teacher, whose task would be to point out the various syntactic, semantic, and rhetorical features of definitions as they occur in actual discourse.

As a final pedagogical point, it is worth noting the potential value also of this research in the training of content teachers who lecture to non-native speakers. A study of the various means available to these lecturers in presenting definitions is likely to enable them to make more effective use of this important speech act in their lectures.

(Revised version received September 1991)
ACKNOWLEDGEMENTS

I should like to acknowledge the help of Lynne Flowerdew, Roger Griffiths, and Vance Stevens, who commented on an earlier draft of this paper, of John Swales, who provided me with invaluable bibliography, of Ray Williams who responded to questions regarding his research, and of A. Lambrou, who sent me key parts of his (unpublished) MA thesis.

NOTES

1 Although there were no instances of definition by example for the category 'formal definition' in the present corpus, it is possible to conceive of such a type, especially where the class word is a 'dummy', for example: 'physical properties are properties like smell / melting point / boiling point' (authentic example from outside the present corpus). The systems network in Appendix 4 consequently includes 'example' as a possible type of formal definition.

2 Space does not allow as full a treatment of rhetorical features of definitions here as would be desirable. See, however, Flowerdew (1991) and Flowerdew (forthcoming) for further work in this area.

3 This is in fact the approach to language learning employed at Sultan Qaboos University, where the research reported here was conducted.

REFERENCES


APPENDIX 1

Lecture topics

SPEAKER A
1. Alkenes: nomenclature and preparation
2. Reactions of alkenes

SPEAKER B
1. The scientific method
2. Measurement and significant figures

SPEAKER C
1. Elements, compounds, and mixtures
2. Ionization energy

SPEAKER D
1. Properties of Metals
2. Ionic Bonding

SPEAKER E
1. Characteristics of living organisms
2. Fine structure of the cell

SPEAKER F
1. Epithelium
2. Structure and development of the root

SPEAKER G
1. Levels of organization
2. Tissue level of organization—hydra

SPEAKER H
1. Chemicals of life: carbohydrates and lipids
2. Chemicals of life: proteins and vitamins
**APPENDIX 2**

*Structure of the database*

<table>
<thead>
<tr>
<th>Field</th>
<th>Field name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TEXT</td>
<td>MEMO</td>
<td>the text of the definition + relevant context</td>
</tr>
<tr>
<td>2</td>
<td>SUBJECT</td>
<td>CHARACTER</td>
<td>a = biology</td>
</tr>
<tr>
<td>3</td>
<td>SPEAKER</td>
<td>NUMERIC</td>
<td>speaker number 1–8</td>
</tr>
<tr>
<td>4</td>
<td>LECTURE</td>
<td>NUMERIC</td>
<td>lecture number 1–2</td>
</tr>
<tr>
<td>5</td>
<td>FORMAL</td>
<td>LOGICAL</td>
<td>definition type ‘formal’, yes/no</td>
</tr>
<tr>
<td>6</td>
<td>SEMIFORMAL</td>
<td>LOGICAL</td>
<td>definition type ‘semiformal’, yes/no</td>
</tr>
<tr>
<td>7</td>
<td>CHARACTER</td>
<td>CHARACTER</td>
<td>type of characteristic—‘behaviour’, ‘composition’, ‘location’, ‘attribute’, ‘example’</td>
</tr>
<tr>
<td>8</td>
<td>SUBTION</td>
<td>LOGICAL</td>
<td>definition type ‘substitution’, yes/no</td>
</tr>
<tr>
<td>9</td>
<td>SUBTYPE</td>
<td>CHARACTER</td>
<td>type of ‘substitution”—‘synonym”, ‘paraphrase’, ‘derivation’</td>
</tr>
<tr>
<td>10</td>
<td>OSTENSION</td>
<td>LOGICAL</td>
<td>definition type ‘ostension’, yes/no</td>
</tr>
<tr>
<td>11</td>
<td>SYNTAX</td>
<td>CHARACTER</td>
<td>type of syntax—copula, apposition, relative clause, pre/post modification</td>
</tr>
<tr>
<td>12</td>
<td>LEXIS</td>
<td>LOGICAL</td>
<td>lexical signalling, yes/no</td>
</tr>
<tr>
<td>13</td>
<td>LEXIS TYPE</td>
<td>CHARACTER</td>
<td>type of lexis—call(ed), mean(s) or, known, that is, performative</td>
</tr>
<tr>
<td>14</td>
<td>NOMINAL</td>
<td>LOGICAL</td>
<td>‘nominal’ definition, yes/no</td>
</tr>
<tr>
<td>15</td>
<td>EMBEDDED</td>
<td>LOGICAL</td>
<td>‘embedded’ definition, yes/no</td>
</tr>
<tr>
<td>16</td>
<td>GROUNDER</td>
<td>LOGICAL</td>
<td>‘grounder’, yes/no</td>
</tr>
<tr>
<td>17</td>
<td>CONFIRMATORY</td>
<td>LOGICAL</td>
<td>‘confirmatory utterance’, yes/no</td>
</tr>
<tr>
<td>18</td>
<td>QUESTION</td>
<td>LOGICAL</td>
<td>rhetorical/elicitation question, yes/no</td>
</tr>
<tr>
<td>19</td>
<td>QUESTFORM</td>
<td>CHARACTER</td>
<td>question form—what/mean, do(es) know, what/call, anyone tell</td>
</tr>
<tr>
<td>20</td>
<td>REPETITION</td>
<td>LOGICAL</td>
<td>repetition, yes/no</td>
</tr>
<tr>
<td>21</td>
<td>LEFTDISLOC</td>
<td>LOGICAL</td>
<td>left dislocation, yes/no</td>
</tr>
<tr>
<td>22</td>
<td>INTMOD</td>
<td>LOGICAL</td>
<td>internal modification, yes/no</td>
</tr>
<tr>
<td>23</td>
<td>INTMODTYPE</td>
<td>CHARACTER</td>
<td>type of internal modification—simply, just, basically</td>
</tr>
<tr>
<td>24</td>
<td>REPORTED</td>
<td>LOGICAL</td>
<td>‘reported’ definition, yes/no</td>
</tr>
<tr>
<td>25</td>
<td>ONBOARD</td>
<td>LOGICAL</td>
<td>graphic support on the black/white board, yes/no</td>
</tr>
<tr>
<td>26</td>
<td>VISUAL</td>
<td>LOGICAL</td>
<td>visual, non-graphic support, yes/no</td>
</tr>
<tr>
<td>27</td>
<td>EMPHATIC</td>
<td>LOGICAL</td>
<td>emphatic stress, yes/no</td>
</tr>
<tr>
<td>28</td>
<td>NOTES</td>
<td>CHARACTER</td>
<td>additional information</td>
</tr>
</tbody>
</table>
### APPENDIX 3

**Number of terms defined per lecture and average time between definitions**

<table>
<thead>
<tr>
<th>Speakers and topics</th>
<th>Length of lecture</th>
<th>Total terms defined per lecture</th>
<th>Average time between definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Speaker A</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alkenes: nomenclature and preparation</td>
<td>50'47&quot;</td>
<td>15</td>
<td>3'24&quot;</td>
</tr>
<tr>
<td>Reactions of alkenes</td>
<td>49'27&quot;</td>
<td>17</td>
<td>2'54&quot;</td>
</tr>
<tr>
<td><strong>Speaker B</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Scientific Method</td>
<td>39'32&quot;</td>
<td>10</td>
<td>3'54&quot;</td>
</tr>
<tr>
<td>Measurement and significant figures</td>
<td>39'27&quot;</td>
<td>9</td>
<td>4'23&quot;</td>
</tr>
<tr>
<td><strong>Speaker C</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elements, compounds, and mixtures</td>
<td>28'13&quot;</td>
<td>18</td>
<td>1'34&quot;</td>
</tr>
<tr>
<td>Ionization energy</td>
<td>38'27&quot;</td>
<td>10</td>
<td>3'51&quot;</td>
</tr>
<tr>
<td><strong>Speaker D</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Properties of metals</td>
<td>48'07&quot;</td>
<td>15</td>
<td>3'12&quot;</td>
</tr>
<tr>
<td>Ionic bonding</td>
<td>52'52&quot;</td>
<td>16</td>
<td>3'18&quot;</td>
</tr>
<tr>
<td><strong>Speaker E</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Characteristics of living organisms</td>
<td>32'24&quot;</td>
<td>12</td>
<td>2'42&quot;</td>
</tr>
<tr>
<td>Fine structure of the cell</td>
<td>48'20&quot;</td>
<td>23</td>
<td>2'06&quot;</td>
</tr>
<tr>
<td><strong>Speaker F</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Epithelium</td>
<td>41'06&quot;</td>
<td>22</td>
<td>2'00&quot;</td>
</tr>
<tr>
<td>Structure and development of the root</td>
<td>35'23&quot;</td>
<td>19</td>
<td>1'48&quot;</td>
</tr>
<tr>
<td><strong>Speaker G</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Levels of organization</td>
<td>41'00&quot;</td>
<td>24</td>
<td>1'36&quot;</td>
</tr>
<tr>
<td>Tissue level of organization—hydra</td>
<td>52'17&quot;</td>
<td>34</td>
<td>1'30&quot;</td>
</tr>
<tr>
<td><strong>Speaker H</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemicals of life: carbohydrates and lipids</td>
<td>47'30&quot;</td>
<td>41</td>
<td>1'12&quot;</td>
</tr>
<tr>
<td>Chemicals of life proteins and vitamins</td>
<td>36'47&quot;</td>
<td>31</td>
<td>1'11&quot;</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>604'40&quot;</td>
<td>315</td>
<td>1'55&quot;</td>
</tr>
</tbody>
</table>
APPENDIX 4

Classification system for definition types used in this study

* There were no instances of formal definition 'example', although this form is theoretically possible. See Note 1.