

"What the Heck is Lymph?"
**Definitions in a Human Anatomy
and Physiology Lecture**

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1. Introduction

In recent years, researchers have become increasingly interested in academic lectures, and their implications for students of English as a Second Language (ESL). In spite of this, in comparison to second language (L2) literacy, "less attention has been given to the description of academic listening and speaking requirements" (Ferris and Tagg, 1996). Scientific lectures, in particular, contain an abundance of potential problems for students - whether those students are native-speakers (NS's) or non-native speakers (NNS's) of English. Because definitions often comprise a major part of scientific lectures, and because note-taking is considered very important by science faculty (Ferris and Tagg, 1996), the speech act of defining brings up a number of pedagogical concerns for teachers of non-native speakers who are involved in scientific lecture settings. As shown in the following definition taken from a physiology lecture, the act of defining is not always cut and dried.

1) what the heck is lymph? If you had a glass of lymph, what would that look like? It is very similar to blood, but there's no red blood cells, red blood cells can't get in there. It's even closer to plasma. Lymph is very close to plasma, in composition. And lymph flows through these lymph vessels and then gets drained back into the circulatory system, right around the heart, so it's a drainage system.

From this utterance, a student can infer that lymph is a liquid, which is close to plasma in composition, and flows through lymph vessels and into the circulatory system. This utterance includes a term, lymph, accompanied by information concerning its composition, appearance and function. This definition, like many instances of spoken English, is not formed in the most exact nor the most precise way due to the fact that spoken English often lacks the precision of written English.

My interest in this research project stems from the English for Science and Technology (EST) course I taught at the University of Minnesota. The

members of this class were primarily graduate students in scientific and technical fields at the University of Minnesota attending mainstream science courses (the members of which were primarily native speakers of English) and at least one ESL class during the same quarter. A portion of this EST course was spent identifying and understanding the content and form of definitions in written EST discourse - which was not a simple task for my students. My students indicated that they didn't think that the format of the definitions that we had encountered in the written texts in EST class were typical of the definitions that they heard in their mainstream course lectures. They, as well as I, were curious about possible methods to recognize definitions in the lectures they attended.

2. Survey of Literature

To my knowledge, the literature concerning definitions found in scientific and technical English (STE), specifically in the spoken context, does not cover as elaborate a corpus as one could hope for. The majority of research that has been conducted (Darien, 1981; Lambrou, 1979; Swales, 1981; Lambrou, Bramki, and Williams, 1984) centers on written definitions in STE, and is based on the work of one of the earliest researchers, Louis Trimble. According to Trimble (1985), the main rhetorical functions of written STE are definition, description, classification, and instructions. During his work at the University of Washington's Applied Linguistics program during the 1970's, Trimble studied STE written discourse, including the rhetoric of definitions. Trimble analyzed and categorized definitions found in written STE discourse (textbooks), work which resulted in two categories of written definitions: simple and complex. A number of studies were inspired by Trimble's work, and these include comparative studies of STE textbooks.

Definition in the spoken context - specifically in the lecture - is a more recent focus of attention for applied linguists. Noting the problems that NNS's have identifying and understanding lectures, a few researchers have taken on the task of extensively analyzing large bodies of spoken data to draw conclusions about the format and frequency of definitions found in lectures given to non-native speakers (NNS) in EFL settings. I will summarize Trimble's conclusions of definitions found in written STE , as well as draw upon Chaudron's work on oral texts, to provide a base for the concept of definition in STE lectures. After this base has been established, I will discuss some of the research studies that have contributed to the field of definitions and Academic Listening and STE.

2.1 Trimble's Notion of Definition

According to Trimble (1985), there are two main types of written definitions in STE. *Simple definitions* consist of one sentence or less, and are subcategorized into formal, semi-formal, and non-formal definitions. The precision of these definitions decreases as the level of formality decreases. The second type, *complex definitions* (also referred to as expanded), consist of more than one sentence, and are usually built around a core statement that is a formal definition. These complex statements are analyzed as paragraph units (focusing on description, causality and result, or classification) and subcategorized into definition by stipulation, explication and operation.

- **Simple Definitions**

A formal definition according to Trimble, contains the most information, and is the most precise. It contains three vital pieces of information, and generally follows the formula: Term = Class + Differences. An example included in Trimble (1985) is

2) "An arachnid is an invertebrate animal having (or which has) eight legs extending at equal intervals from a central body" (p.80).

The class "invertebrate animal" serves to relate the term "arachnid" to a larger category, and the differences "having (or which has) eight legs extending at equal intervals from a central body" serve to clearly identify the term, and to differentiate it from other members of the same class. This formal definition can be expanded to a paragraph (or multiple paragraphs) if the author wishes to elaborate.

A semi-formal definition contains almost the same amount of information as a formal definition, but omits the class. This occurs because the class is either obvious due to the context (e.g. 'Huntington's Disease is a disease' in which the name is descriptive of the category), assumed (e.g. biology is a science), or because it is too large to add any useful meaning (e.g. magnetism is a phenomenon). Semi-formal definitions are regarded as supplying the same amount of information as a definition which supplies the class (a formal definition), unless the class is a vital piece of information that would give a clearer understanding. "An arachnid has eight legs extending at equal intervals from a central body" (Trimble 80) is an example of a semi-formal definition which would be clearer if the class were supplied. However, given the context, a reader could probably assume, or would know the class.

A non-formal definition is the least informative and the least precise of Trimble's three types of simple definitions. Its purpose is to give the readers a general understanding of the term, and possibly connect it to something they are familiar with. It does not function to supply "precise defining information" (Trimble 85). The non-formal definition often occurs in the form of a synonym, an antonym, a paraphrase, or by a mention of the term's most outstanding characteristic.

3) "*An arachnid (spider)*" (Trimble 80).

4) "*but formants, that is the true resonants of the vocal tract, will lead to spectral peaks in the same frequency region for a given configuration of the tract*" (Frye 78).

- **Complex Definitions**

As mentioned previously, a complex definition in EST written discourse serves to elaborate on a specific term, which may be introduced in a formal definition format; the complex definition can encompass a single paragraph, or even groups of paragraphs. A complex definition is normally based on a formal definition as the core statement, and provides an expanded understanding of a term. The three types of complex definitions most commonly found in the EST written discourse that Trimble surveyed were: definition by stipulation, explication, and operation. Trimble also mentions other ways to expand: by description, classification, and exemplification.

Definition by stipulation serves to set limits to the meaning, time, place or boundaries of a main definition by stating in what sense or explicit context the word is being (or can be) applied or used. These are found commonly in

mathematical and legal writing, and in EST when a scientist coins or uses a new term, or applies a term in an unusual way. Legal documents often contain definition by stipulation, as seen in the following example from Trimble, where the limits of the use of the term "special tooling" are set to include only explicit types of equipment (jigs, dies, fixtures, molds and patterns):

5) *The term, "special tooling", as used in this clause, includes all jigs, dies, fixtures, molds, patterns ... and other special articles of equipment (Trimble 81)*

An operational definition tells the reader "what to do in order to experience -- physically and / or mentally -- whatever is being defined" (82).

The following is an operational definition of a labio-dental fricative.

6) *The sound [f] is a voiceless, labio-dental fricative, formed by placing the lower lip lightly against the upper teeth, closing the vellum, and forcing the breath out through the spaces between the teeth or between the teeth and the upper lip (Trimble 82)*

Definition by explication was commonly found by Trimble in STE beginning textbooks and manuals, and serves to give the reader more new information about the term that is originally defined. The original definition is often restated in the form of synonyms to further clarify the meaning of the term.

7) *Agronomy is a science which seeks improved methods of soil management and crop production. By crop production we mean new techniques that will increase the yield of field crops. By improved soil management we mean the use of fertilizers which contain the necessary nutrients needed for the crops (Trimble 83).*

2.2 Chaudron and Elaborations

The work of Chaudron (1982, 1986) is of pertinence to this study because not only does it build on the notion of definition as a rhetorical function,

but it focuses on the spoken classroom context rather than written discourse. In his 1982 study of 19 different lessons given to students in Canadian schools, Chaudron focused on ways that teachers *elaborated*, or "defined, qualified, questioned, repeated, paraphrased, exemplified or expanded upon", terms (p. 171). These courses (varying from high school ESL to first year university courses like English, Geography, Art, History, Social Science, and Canadian society) were instructed by seven different native speaker teachers; sixteen of the classes were attended solely by NNS's, and three classes were attended solely by NS's (i.e. the listening groups were not mixtures of NS's and NNS's). The results of his study highlight the use of "teacher talk" in the classroom, with a comparison of how teachers' elaborations will differ when addressed to NS and NNS listeners.

The work of Chaudron is important to the present study primarily due to his use of the concept of elaboration in spoken discourse. Unlike written discourse, spoken discourse is often not organized into a format that makes it the most clear, efficient and precise for a listener. For this reason, it is difficult to apply the rules of written discourse (like Trimble's) to spoken discourse, even in a field like STE where one would hope to find a fairly precise relay of information.

Chaudron's idea of "elaboration" is useful because it is broader than the rhetorical function of defining, and gives us more space to interpret and analyze spoken English on a macro scale. It acknowledges the fact that spoken English occurs on a larger than sentence-level scale. This notion leaves room to include instances of speech in which lecturers may not be direct, clear or purposeful with the information they are presenting. Although Chaudron's approach is useful, it is important to point out that lectures are literally filled with elaborations, only some of which are important for a student to understand. My

educated guess is that most students, including myself, have witnessed a lecturer elaborating on unnecessary material and giving information that students are not responsible to know on a test, nor that they need to know in the long run. I feel this category is a bit too broad to accurately narrow down and select instances from lectures for analysis. For a NNS, an understanding of this structure may not prove to be as useful as an understanding of the spoken definition, one of the basic functions of STE. I feel that it is most useful and within my abilities to research and discuss a more acute point, namely defining.

2.3 Studies concerning definitions and elaborations in STE lectures

Much like a written context, in the spoken context, the messages relayed by a lecturer may be a mixture of definition, description, classification, or instruction, and the same message may serve to complete one or more of these functions at the same time. What is most important (and problematic) to this study is that a speech-act must ultimately be interpreted by a listener, and understood as a definition when appropriate. At times, the form of an utterance may clearly signal its function. However, at other times a speech act can be interpreted as being more indirect; that is, the form is not so clearly related to the function (Searle, 1975). At times, this may indeed be the case with the function of the spoken definition. In order to help the NNS listener better understand and recognize definitions, a thorough description of the speech-act of defining in the target context (both linguistic and geographic) is very important.

The format and context of definitions in STE lectures has recently received attention from applied linguists at Sultan Qaboos University in The Sultanate of Oman . The medium of instruction for mainstream courses at this university is English, and the problems arising from the lectures "are seen as

almost exclusively vocabulary problems" (Arden-Close 1993). The problem of vocabulary is not a stranger to any foreign or second language student or teacher, and therefore these studies are of great interest to me.

Arden-Close (1993)

In a study based on data collected at Sultan Qaboos University, an English-medium university in the Sultanate of Oman, Arden-Close (1993) discusses the kinds of language problems that NNS Omani students of science had in lectures given by English and American science instructors. Because the language problems seemed primarily to be vocabulary problems experienced during the explanation of a new term, Arden-Close focuses on the more difficult aspects of the definitions and explanations that these Omani students encountered in their lectures. Through analysis of lectures, as well as student and teacher interviews, the researcher's results showed numerous aspects of the vocabulary explanations to be problematic, including "the problem of finding concrete analogies for invisible entities, heightened by the fact of lecturing in a foreign culture; the problem of using "synonyms" in explaining words; the problem of scientific words which have another meaning in everyday life; and the problem of finding a common range of reference" (260).

Much of the published portion of this study was teacher-focused rather than student-focused (as opposed to the U of M study which is exclusively (spoken) text focused). Arden-Close based his study primarily upon interviews accompanied by lecture transcripts, which revealed the struggle on the part of the teachers to choose their words carefully, and their attempts to avoid the introduction of terms that students may not have encountered in the past. Arden-Close writes of problems with the synonyms that lecturers supplied as definitions, and of a "limited area of common reference" between the students

and the lecturers which made understanding analogies, asides, and comparisons problematic for students. Although the teachers involved in this study admittedly adjusted their output to better insure that students would comprehend the meanings and definitions supplied in the lectures, the researchers were not optimistic about how well these science students learned the new terms and increased their scientific knowledge because the teachers did not point out the contexts in which the terms should be used, and did not differentiate them from other closely related words / synonyms.

One of the main reasons that this study is important is the fact that although these teachers were not EFL teachers, nor trained in TEFL, they openly admitted that some adjustment of their lexicon naturally occurred, and was necessary. This supports the idea that lecturers will probably adjust their output when lecturing to groups of NNS; this will be discussed more fully in the second part of this paper. One surprising finding of Arden-Close's research is that some of the adjustments made by the teachers (avoiding unfamiliar words, using simpler synonyms, using analogies that students were unfortunately unable to relate to) may have hindered the learning of these new vocabulary items and furthering of the scientific knowledge of the students.

Jackson and Bilton (1994)

Another study dealing with the presentation of new terms in science lectures at Sultan Qaboos University is based on a series of geology lectures given by two British professors on one-month assignments in Oman. In their work, researchers Bilton and Jackson for unspecified reasons chose to incorporate Chaudron's preferred term "vocabulary elaboration" and in their corpus identified "all instances of the use of special terminology or expressions that the (lecturers) in some way qualified, explained, questioned, repeated,

paraphrased or expanded on" (Chaudron 1979:5). Although an elaboration is not a definition *per se*, the two functions often include similar information. That is, all definitions are elaborations, but not all elaborations are definitions. Therefore, the data collected concerning elaborations also concern definitions. Jackson and Bilton quantitatively analyzed how these "elaborations" (a base term followed by a reformulation, a reformulation being one or more expressions of the same idea) were most commonly patterned, which linguistic features tended to accompany them, and the differences that occurred between the two lecturers. For each of the 921 elaborations found, the researchers analyzed for:

- a. *the pattern of reformulation (type and density);*
- b. *the position and function of discourse markers;*
- c. *the speed and stress of delivery;*
- d. *verbal signals of importance ("You'd better get this down");*
- e. *the type of explanation (definition, synonym, paraphrase);*
- f. *the technicality of items (technical, semi- or non technical) (p.67)*

a. Pattern of Reformulation: The researchers found that the most dominant pattern (80%) of reformulation was what they called the "AB elaboration" ("a base word followed by a simple elaboration like *clasts- stones*") (66). The second most common (~10%) were "verbal mazes", or elaborations including up to seven elaborations within the primary one. One such example of a verbal maze began when the teacher attempted to explain what a conglomerate was. In the following example the elaborated terms are underlined.

20) Conglomerates - rocks in which pebbles are rounded - and they're bonded together held together . by finer sediments or by cement the -- same word as for cement that we use for building . uh it just means sticking together . . so a variety of different minerals . can act to hold together . there are -- some of this is cemented by iron compounds . . so conglomerate roundy rounded pebbles . held together . all all conglomerate means is a bringing together . uh . you can also have a number of companies in business . that you join together . then they are also called a conglomerate . so conglomerate just means . many different things together (66)

In this "verbal maze" we see how the lecturer, in his attempt to define "conglomerate", ends up with 5 different attempts to give meaning to the new term within the same chunk of speech. Following Flowerdew (who does not deal with these "verbal mazes" or any type of expanded definition), this example would be classified into a database as seven definitions including the terms "conglomerate"(5 times), "bonded together", and "finer sediments". Although Trimble (1985) does deal with expanded definitions, the expansions he describes consist of a core statement to which related information is added. In a verbal maze, information is added, but it is not necessarily clearly related to the original statement.

b. Position and Function of Discourse Markers: 64.2% of the 921 elaborations were entered directly, and did not use any kind of discourse marker to signal the beginning of an elaboration. About 50% of elaborations contained a sentence connector like "and", "or", or "so". About 52% of elaborations were concluded with a discourse marker like a pause, "good", "OK", or "right".

c. Speed and Stress of Delivery: The researchers did not feel that this study showed any alteration of speed and stress, or systematic use of foreigner talk by lecturers with the NNS geology students. There was little overt emphasis put on the beginning of an elaboration, and only 62% of the exits (endings) were stressed. Also, the elaborations themselves were only slightly emphasized or separated from the rest of the content .

d. Verbal Signals of Importance: 8.3% of the elaborations included signals of importance like "you should remember this".

e. Type of Explanation: Half of the corpus consisted of definitions that were structured in one of the following formats: "that is called," (...that is called a conglomerate) "this / x means" (a conglomerate means...), " we define / describe as" (we define a conglomerate as), " x / this isa (kind/type of)"(a conglomerate is a kind of ...)

f. Technicality of Items: Of the 921 base terms, 55.8 % were found by the researchers to be technical, 33.8% were non technical, 10.6% were semitechnical. Technical and non technical language (with a nearly even split) was used for 90% of the first reformulations given for terms. In the following example, (T) precedes technical information, and (N) precedes non technical information.

21) The (T) lustre of a mineral is (T) the property . . the . . of the mineral to reflect light . . so it's (N) the appearance of . . of the surface of the mineral in reflected . . light (72)

Examples of semi-technical language were not included in the article.

Flowerdew (1991a, 1991b, 1992)

In a study focusing on lectures given by English native speaker science teachers to a group of NNS students at Sultan Qaboos University in Oman, Flowerdew (1991a) analyzed sixteen scientific lectures (two lectures given by each of four biology lecturers, and two lectures given by each of four chemistry lecturers; the lectures varied from 28 minutes to 53 minutes in length) for the frequency, distribution, function, and form of definitions. Drawing on the work of Olshtain and Cohen (1983) regarding the "accurate description of the speech-act set in the target language" (33) that is necessary for appropriate syllabus design and choice of course content, Flowerdew collected data in order to describe the speech-act of defining so that he would be able to draw conclusions concerning the format and frequency of definitions in academic STE lectures.

"A comparison between how lecturers define in lectures and how the language of definition is presented in EAP 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" (Flowerdew 1991a: 203).

The main limitation of this study is that Flowerdew does not include the criteria that all the utterances had to meet in order to qualify as definitions. He followed up that study with an analysis of pragmatic modifications and salience within the same corpus (1991b, 1992).

In his first study (1991a), Flowerdew extracted definitions that occurred in the 16 science lectures and entered them into a computer database according to linguistic and paralinguistic features. One problematic aspect of the study was the omission of explicit criteria for his four types of definitions. This may cause difficulty in understanding which terms in the transcribed lectures qualified as "definitions" in Flowerdew's study. Were only the terms which

supplied precise defining information or characteristics that differentiated the term from the other members of some assumed class considered definitions, or were other characteristic descriptions of terms also accepted? It is not totally clear, and it is not possible to clarify this matter due to the fact that a list of the accepted "definitions" was not published, nor were the factors that were necessary in order to identify a speech item as a definition.

Focusing on five categories, Flowerdew's data showed the following results concerning definitions (however they were identified) in the STE lectures:

- ***Frequency:*** a definition occurred every 1 minute 55 seconds.

In the sixteen lectures which constitute Flowerdew's corpus, the average frequency was one definition every 1 minute 55 seconds. Of the eight lecturers that were analyzed, the lecturer with the highest rate had 1 definition every 1 minute 11 seconds, and the slowest had 1 term every 4 minutes 23 seconds. The length of the lecture did not provide any significant evidence for variation of frequency. In the lectures which were longer in length (over 45 minutes), the average frequency was one term every 2 minutes and 41 seconds; those which were shorter in length (from 28 to 41 minutes), had an average frequency of one term every 2 minutes 24 seconds. It is also important to note that only 2 of the eight lecturers at SQU defined more frequently than once every 1 minute 30 seconds.

One point that Flowerdew does not explore in his article (1991a) is the frequency differences that occurred between the biology lectures and the chemistry lectures. The SQU corpus contained 8 biology lectures and 8 chemistry lectures. The biology lecturers (4) provided definitions at a higher frequency and averaged one definition every 1 minute 46 seconds. The

chemistry lecturers (also 4) averaged one definition only every 3 minutes 19 seconds. Thus the frequency of definition may be subject matter related.

- **Distribution:** definitions tended to be grouped together
- **Function:** definitions served the purpose of either signposting the structure of the lecture, or helping to maintain comprehension of listeners
- **Form:** definitions could be classified into three main categories (formal, semi-formal, substitution), which in turn could be subdivided. A small portion of the definitions were defined by ostentation (using a visual stimulus)

In his classification of definitions into types, Flowerdew draws on the work of Trimble for two of his four types of classification. The first type is the "Formal Definition", which like Trimble's, includes the Term + Class + Differentiating Characteristics, often phrased as "An A is a B which C" (209). Also, he found that some formal definitions included a "dummy" (210) class word, in which the class was supplied through a repetition of the term or some type of referential word as in the following examples.

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

9) (reference) . . . a quantitative observation is one that tells us how much of something rather than just the kind of object . . . ('dummy' underlined)
(Flowerdew 210)

Following Trimble, Flowerdew's second type of spoken STE definition is "Semi-Formal", which means that the definition does not have the class included, but does include information concerning "a key characteristic or characteristics" (210).

10) *..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 (211)*

Flowerdew states that spoken definitions will differ from written ones due to the false starts, hesitations, and repetition that naturally occur with spoken discourse. What may cause confusion for the reader is Flowerdew's use of the term "key" in describing the characteristics which accompany a semi-formal definition, and the fact that he does not include a definition nor clarification of his use of this term. It is problematic for a researcher to understand which range of characteristics were considered to be "key" to a particular term, and to understand if "key" was used in an objective manner. Given the following semi-formal example from his 1991a article:

11) *a stable electronic configuration is like the inert gases*

accompanied by the fact that his article does not include many examples, his criteria could be interpreted as somewhat liberal.

The third category that Flowerdew arrived at was "Substitution", in which a synonym (12) ". . . fuse / by fuse I mean join together") (211), paraphrase (13) "electropositive is likes to become positively charged") (211), or derivation (14) "a structure called the cytopharynx / cyto meaning cell . . . and so cytopharynx just means the pharynx of the cell") (211) is substituted for the term that is being explained.

The final category, which in Flowerdew's data does not occur frequently, was definition by "ostentation" (212), in which the lecturer uses a visual prop like a photograph or a chart, or simply points, in order to define a term. In one

called / are called / called. Some of his examples also used the words: *mean, known as, defined, and that is*. *That is* carries out the same function as *i.e.* in writing; "A hammer, that is a tool for knocking in nails- is an essential piece of equipment". (Flowerdew, personal email communication 1998).

2.4 Discussion of recent research and its implications for English for Academic Purposes (EAP) syllabus design

Descriptions of language used by teachers in foreign and second language classrooms are very useful for language teachers and applied linguists. As we prepare students for mainstream academic situations in the United States, it is important to take into consideration the language used by mainstream NS instructors (namely lecturers) to convey information to NS listeners. In these settings (where NNS's may or may not be present) the language is likely to be different than the language that is used by ESL and EFL teachers. In settings like US university and continuing education programs, lecturers may not even be aware of the presence of NNS's in their audience (see Rollo 1996), and will most likely not simplify or alter their language for accommodation purposes. A description of the language used in this "target situation" could provide a valuable tool for teachers to better prepare their students for what lies ahead. I wholeheartedly agree with Ferris and Tagg (1996), who state that "to equip EAP [English for Academic Purposes] students for the variety of challenges awaiting them, EAP instructors, materials developers, and teacher trainers need to be aware of what is really happening in college / university classes today" (Ferris and Tagg, 1996).

Although Flowerdew admits that he was motivated "by a very specific pedagogic situation" (1991a: 203), and that "characteristics of definitions are likely to vary according to the subject matter and audience" (215), he seems to

apply his findings to science lectures in general, in any context (as indeed his title "Definitions in Science Lectures" would lead a reader to believe).

"The results of this study provide a solid framework for teaching the language of spoken definition in science, whether receptively or productively . . . provide potential input for syllabus design" (Flowerdew 1991a: 215). The question we must ask ourselves is: keeping in mind the classic ESL / EFL vs. mainstream dichotomy, can conclusions drawn from an EFL database be used to make generalizations about native speaker dominated academic situations like mainstream university classes? Chaudron (1982) found evidence of alteration of speech for NNS audiences in EFL settings, and the SQU lecturers interviewed by Arden-Close (1993) spoke at length about the necessary alteration of their speech in lectures. Although the teachers in the Jackson and Bilton study did not feel that they were using teacher talk, it is very possible that they also were altering their speech, maybe without realizing it. Should analysis of STE data collected in an EFL setting be used to design course content aimed at students whose goal is to improve their comprehension of mainstream lectures in the United States? The following research is done in order to give insight into this pedagogical concern.

3. Research Questions

In an attempt to test the validity of Flowerdew's findings for U.S. contexts, this study focuses upon four research questions taken from his 1991a article, asked this time in the context of an American university:

- 1. How frequently do definitions occur in the undergraduate science lecture that makes up the corpus?*
- 2. What are the different types of definition and what are their distinguishing characteristics?*
- 3. How are definitions signaled linguistically?*
- 4. What particular rhetorical features accompany definitions?*

4. Method

a. The Corpus

The corpus of data used in this research project was collected and transcribed by T. Rollo during the Spring of 1996 with the purpose of observing and identifying the format of a mainstream lecture (Rollo, 1996). After consideration of the constraints of his own academic schedule, he chose the University of Minnesota General College Human Anatomy and Physiology course. He then contacted the instructor, who after some discussion regarding the reasons for the request, granted Rollo permission to attend and record his lectures. Because the lecture was coincidentally being video-recorded for possible use in a distance learning course, Rollo was also able to obtain a video recording which he then transcribed in its entirety (text in Rollo 1996). The transcription consists of an hour-long lecture on the lymphatic system. General College (GC) at the University of Minnesota "enrolls, and prepares for admission to University degree programs, students who require special

preparation because of personal circumstances or previous education" (<http://www.gen.umn.edu/gc/mission.html>). The implications of this research context are discussed on page 43.

The students in this lecture were primarily native-speakers of English; there was, however, one NNS enrolled in the course. Due to an increasing number of NNS's who enroll in General College courses, it would not be at all uncommon for more than one NNS to be in a course like the one analyzed. It is, however, the norm for General College courses to have more NS students than NNS students. The audience, which is dominated by NS's, constitutes a major difference between the present study and that of Flowerdew. As Rollo notes regarding this data and the factors surrounding it,

"During my first brief introductory conversation with the lecturer in question, it became clear that he had little or no idea as to whether or not there were any non-native speakers of English in his class. I was witnessing, first-hand, the reality regarding the awareness, or rather lack thereof, of the NNS in mainstream academic classes . . . Further investigation and collaboration with the TA did in fact reveal the presence of a single NNS student" (25).

This lack of awareness on the part of the instructor is probably not all that uncommon in large university settings where the lecturers have a limited amount of one-on-one interaction with their students, and would therefore have very little knowledge of their students' proficiency in English. Thus it seems likely that the language input on the part of the teacher in this mainstream course could, and probably does, differ greatly from that provided in an EFL setting such as the one described in Flowerdew (1991a). This also raises the question: would the lecturer change the lecture if he or she were aware of NNS in the class?

b. Data Analysis

As mentioned previously, in his 1991a article Flowerdew does not include any criteria which utterances had to meet in order to qualify as definitions. Therefore, in an attempt to replicate Flowerdew's (1991a) analytical methodology, the researcher had to choose which utterances in the Anatomy and Physiology lecture qualified as definitions, and would be extracted from the lecture for analysis. To make this choice, a set of criteria had to be created so that the definitions could be identified in a systematic manner. After a preliminary analysis of the data, the following criteria for a definition were determined:

- the utterance included a term accompanied by characteristic or characteristics of the term, and / or its class
- the utterance was given by the lecturer with the apparent purpose of helping the students understand the meaning of a term or of a specific aspect of a term
- the researcher intuitively understood the information which was presented by the lecturer was primarily completing the speech act of defining.

If the utterance fulfilled all of the above criteria, it was used as part of the corpus of definitions that were analyzed. The reader may feel that this is a liberal use of the term definition; this, however, was necessary because naturally occurring speech often lacks the formal structure of written language, and the structures used vary greatly. Chomsky (1965), in his dichotomy of performance and competence, explores this variation of spoken language which is caused by "memory limitations, distractions, shifts of attention and interest, errors, deviations, semantic reference . . . and situational context" (Cook p.5). Because the lecture was not scripted and contained naturally occurring speech, some

leeway had to be given in order to allow an utterance departure from standard written structures.

In distinguishing formal definitions, Flowerdew follows the work of Trimble (1985) who had gone back to the teachings of Aristotle to characterize formal definitions as having the semantic structure of "term, class, and distinguishing characteristic(s) (in paradigm form 'An A is a B which C')" (1991:209). The researcher felt that exclusively using Trimble's notion of differentiating characteristics was not sufficient for spoken data due to the fact that in a lecture, the function of explaining a new term is often partly to classify the term (identify the class to which a term belongs), and not necessarily to differentiate it from other members. Following the work of Trimble (1985), classification and definition can simultaneously occur; he found that classification occurred in written STE with expanded definitions and descriptions. As in writing, I feel that these two rhetorical functions (defining and classifying) should be allowed to overlap, keeping in mind the differences which Trimble (1985) sets forth:

...there are two essential differences between the rhetorical functions of formal definition and classification: the first is that definition deals with only one member of a class while classification deals with all (or the most important) members; the second is that the statement of difference in a formal definition has as its purpose the isolation of the term being defined, while its counterpart in classification, usually called the 'basis for (or criterion of) classification', has the purpose of naming something that is shared by all members of the class (p. 86).

As discussed previously, Dr. Flowerdew's use of "key" characteristics in extracting definitions was not well enough defined to permit application to this study. Therefore, the reader should be aware that it is entirely possible that the corpus chosen for the present study differs in criteria from the corpus used by Flowerdew.

Each definition, along with the surrounding contextual information, was extracted from the lecture and recorded in a database. These definitions are listed in Appendix A. Each definition was analyzed for 24 features related to its lexical, syntactical and paralinguistic features (see Appendix B).

5. Results

1. How frequently do definitions occur in the science lecture that makes up the corpus?

From the Human Anatomy and Physiology transcript, which represents one hour of lecture time, 64 definitions were extracted, referring to 51 different terms (eight terms were each defined more than once during the lecture). Averaging these out over the course of an hour, one definition occurred roughly once every 55 seconds.

2. What are the different types of definition that occur in the U of M science lecture?

The definitions found in this lecture, as in Flowerdew (1991), were organized according to four categories: Formal, Semi-formal, Substitution, and Ostension. All of the definitions in the US physiology lecture fit into at least one of these categories. It was, however, common to find terms that were explained using more than one type of definition. The lecturer often supplied a substitutional definition for a term in addition to a formal or semi-formal definition; these were counted as one definition. Only the cases in which substitution occurred alone were classified as definition by substitution.

A. Formal Definitions

a. Definition Form

According to Trimble (1985), a formal definition in STE contains three elements: the term, the class, and distinguishing characteristics. Adhering to these guidelines, a significant portion, about one-third (22), of the 64 definitions found in the physiology lecture could be classified as formal definitions, including the following example, which includes the typical information and format for a formal definition:

*22) pretend you're a **pharmacologist**, that's the person who invents or designs drugs, a person who makes enough drugs to specialize in designing novel hormones...what would be the hormone that you would most want to make?*

As in many definitions throughout the physiology lecture, redundancy was built into this definition. This aspect will be explored more in the discussion of the rhetorical devices which accompany definitions. As in the Flowerdew corpus, the ordering of the elements was varied (Flowerdew 1991). Of the 22 formal definitions, 16 were ordered with the term at the beginning of the definition and 7 were ordered nominally (i.e. the term came after the class and characteristics).

One difficulty that was encountered by the researcher when identifying the definitions revolved around the fact that many of the formal definitions in the U of M corpus supplied characteristics that were not necessarily characteristics which distinguished that term from other members of its class, thereby fulfilling Trimble's requirement for formal definition. As mentioned earlier in this paper, the rhetorical function served by a spoken definition is often to relate a term to other members of the class (overlapping with classification) or to the topic at hand, not to differentiate it. The following definitions are taken from part of the lecture where the professor is talking about edema, and a disease which includes severe swelling:

23) **Elephantiasis** is not a disease that you will find in Minnesota, it is a disease that you will find in many, many many tropical countries....
Elephantiasis means your organs, or your limbs, or whatever, begins to look more like an elephant than it does a human.

After explaining the cause of this disease and defining a few other words, the lecturer goes on to talk about the derivation of the word. Although the information provided does not differentiate it from all other diseases that occur in tropical countries which include swelling (like leprosy, roundworm disease, and trypanosomiasis) (<http://www.travelhealth.com>), the researcher thought that it was likely that the goal of the professor was to simply relay that elephantiasis is a tropical disease that includes severe swelling. Taking this into account, as well as the fact that Trimble's theory was created with written STE in mind, it was decided that all characteristics, not only those which distinguish a term from other members of its class, were considered to complete the requirement for "characteristics" in the spoken context.

Six of the 22 formal definitions in the U of M corpus contained "dummy" classes (a repetition of the term or a reference word that served as the class). In the following examples, the term being defined is in bold, and the dummy class word is underlined.

24) **tropical countries**. You know, the countries that are between the Tropic of Cancer and the Tropic of Capricorn, where it's warm.

25) what an **antigen** is, is something that can cause your immune response to turn on. Something that can stimulate your immune response. Something that can trigger it, turn it on.

One interesting example encountered in the corpus that doesn't exactly fulfill the standard idea of class, nor of 'dummy' is shown in the following:

26) Now...**edema** (points at board)...it's a lymphatic thing, things aren't draining quite right things aren't draining quite right, there's more fluid out than coming back in and the lymphatic system is not doing its job well enough to get it back in circulation, you know to get it back into the system

Another dummy class that is hard to deal with is exemplified in the following formal definitions:

27) ***bacillus anthrax***, that's the name of the organism that causes it

28) Well see that word ***protozoans***, that's the name of a, that's the general name of the critter that causes it,

29) ***trypanosome brucei brucei***, is actually the name of thing that causes the worst form

In the previous three examples, the dummy class seems to have a lexical signal included. Also, it seems as though the lecturer may be trying to define the word in metalinguistic terms. This class-type was not identified in Flowerdew's corpus and doesn't seem to fit in with his findings.

b. Semantic Function

The formal definitions from the U of M physiology lecture were categorized into Flowerdew's four semantic categories (behavior / process / function, composition, location / occurrence, and attribute / property). Many belonged to more than one category.

- Sixteen of the definitions fit into the behavior / process / function category, including the following example:

30) *drugs called immunosuppressant drugs*, that push down the immune system.

- Five fit into the location / occurrence category. The following example was also categorized under attribute:

31) **tropical countries.** *You know, the countries that are between the Tropic of Cancer and the Tropic of Capricorn, where it's warm.*

- Six were categorized as attribute / property definitions, including the following example:

32) **Immunology** *is probably the fastest growing area of human biology right now, and it's linked in with the lymphatic system*

- One formal definition was found to belong to the appearance category and composition category:

33) **Lymph.** *Is lymph a solid, liquid, or gas? Liquid, what's it most like?...Plasma. Plasma. What color do you think it might be?...Clear. Clear, mostly water, it's going to be clear, there's white blood cells in there.*

B. Semi-Formal Definitions

a. Definition Form

Semi-formal definitions include the term and characteristics, but omit a class. According to the analysis done with the U of M corpus, about one-third (or 22 of the 64 definitions) are classified as being semi-formal. Both +nominal and -nominal examples were found. In the vast majority (20 of 22), the term is mentioned before the characteristics (-nominal); in two examples the ordering is nominal.

b. Semantic Function

Following the work of Flowerdew (1991) regarding semantic content, the semi-formal definitions are classified into the following categories:

- Fourteen describe the behavior / process / function of the term:

34) *What does a **spleen** do? SR: It's not a bone, is it? TR: No it's not a bone...no. Splens are associated with fighting infection, but the common one is destroying red blood cells. When red blood cells get too old, they're gone, they have got to get destroyed somehow and so your spleen is responsible for chewing up red blood cells, recycling them.*

- Four describe the location
 - 35) *But your **tonsils**, you know in your mouth, let's see if you have a picture of the tonsils...*
- One belongs to the attribute / property category
 - 36) ***hysto**, hysto has to do with tissues like hystology,*
- Three are in an "example" category (which Flowerdew mentions but does not include as a separate semantic category)
 - 37) *Spleen, thymus, tonsils, these are the **major lymphatic organs**.*
- Three belong in the appearance category.
 - 38) *Elephantiasis means your organs, or your limbs, or whatever, begins to look more like an elephant than it does a human.*

C. Substitution

Flowerdew's third class of definition is substitution, in which "a word, word-part, phrase, or phrases with a similar meaning, is substituted for the newly introduced term" (209). This category is quite noticeable in the U of M data; 20 of the 64 definitions include some type of substitution. It was not unusual for the lecturer to use a substitution in addition to a formal or semi-formal definition. However, 14 of the substitutions occur alone. They are categorized, as in Flowerdew, as either synonym, paraphrase or derivation.

-synonym

39) *the general term for **swelling** is edema. The general word for swelling is edema.*

- paraphrase

40) *We're just going to say it's **immunological**, it's going to fight diseases.*

41) ***heart transplant** that means the heart came from somebody else,*

- derivation

42) ***Phago**, what does that word mean? Eat*

43) ***MHC** proteins, major hystocompatibility*

As mentioned previously, the lecturer supplemented some of his semi-formal and formal definitions with substitutions, and vice-versa. The data show 3 semi-formal definitions supplemented by a substitution, like example (1) repeated below:

*1) what the heck is **lymph**? If you had a glass of lymph, what would that look like? It is very similar to blood, but there's no red blood cells, red blood cells can't get in there. It's even closer to plasma. Lymph is very close to plasma, in composition. And lymph flows through these lymph vessels and then gets drained back into the circulatory system, right around the heart, so it's a drainage system.*

There are 3 formal definitions supplemented by a substitution, like the example below:

44) Pathogens are things that cause disease, pathos,

D. Ostensive Definition

Flowerdew's last type of definition is ostensive definition, which "is performed by indicating some visual stimulus such as an object, a photograph, or a diagram" (212). Several (15 of the 64) of the definitions in the U of M corpus included some type of visual support. However, to be considered a definition solely through ostension, the visual stimuli could not be accompanied by a verbal definition. Six of the 15 examples with visual support qualify as definition solely by ostension, including the following example, in which five terms are ostensively defined.

*45) Now let's look at something on page 242, 424. I think it's 424, 424, figure 61 shows you a picture of a **heart**, of **arteries**, **veins** and **capillary beds**. And then the **GREEN** (stressed) stuff, the **lymphatic system** is typically shown in green and yellow. The green stuff starts at the capillary beds and then it shows you lymph flow*

In the previous example, *heart*, *arteries*, *veins*, *capillary beds*, and *lymphatic system* are visually illustrated using a diagram in the students' book. The

lecturer does not supply a verbal definition (a criterion for definition by ostension), and uses the picture to deliver the semantic content (location and appearance) of the items.

3. How are the definitions in the physiology lecture signaled linguistically?

There are certain syntactic and lexical devices that occurred frequently in the U of M spoken definitions. The results from the corpus are as follows.

A. Syntactic signals

In the U of M corpus, the copula was the most prevalent signal. It occurred in 53% (34 of 64) of the definitions; 64% of the formal definitions used the copula, 55% of the semi-formal definitions used the copula, and 40% of substitutions used the copula. Apposition was not frequent in the U of M data; it occurred in 6 examples.

The relative clause occurred in 16% of the definitions, all of which were formal definitions and followed patterns similar to the following example:

46) a molecular immunologist. You know a person who works on how people fight diseases on a molecular level,

There are a number of syntactic features that occur frequently in the U of M data which were not reported from the Flowerdew data. The first of these features is the use of the negative while defining. Although Aristotle, according to Edwards, believed that "one should not define by negative terms" (Edwards 1967:322), this did occur in the U of M data.

*47) Now there are a lot of diseases in humans that are not caused by organisms, like Huntington's, that's a **genetic disease**.*

48) *Auto-immune disease, that's the next word I want you to write down. Auto-immune diseases, these aren't caused by bacteria, by fungi, they aren't caused by some germ. Auto-immune diseases are caused by your immune system having an identity crisis. Your immune system attacking itself.*

(It should be kept in mind that Aristotle also believed that words should not be defined via synonym, which both Trimble and Flowerdew have recognized as valid.)

Defining by means of a 'question and answer series' also occurs in the data. Although students rarely answered or interacted with the lecturer, questions from the teacher, whether they be rhetorical or otherwise, seem to play an important part in the lecture. One of the functions that questions fulfill is creating a structure for definition, and is demonstrated in the examples below.

33) *You have lymph. Is lymph a solid, liquid, or gas? Liquid, what's it most like?...Plasma. Plasma. What color do you think it might be?...Clear. Clear, mostly water, it's going to be clear, there's white blood cells in there.*

49) *How does your body fight diseases in a non-specific way? Well, without a doubt the number one tool to help you fight disease, is....what?...(inaudible student answer) No, non-specific, the most superficial organ in your body, (student replies "skin") skin your skin is a very nice variant.*

50) *Someone gets a heart transplant that means the heart came from somebody else, you want your body to fight that organ? Is it possible that it will? What's that called? SR: Rejection Rejection, your body is rejecting the kidney, your body is rejecting the heart.*

Another noticeable syntactic feature of spoken definition includes the use of the second person singular ("you") when explaining terms. The lecturer very often referred to a term or concept in a way that connected it to the listeners, as demonstrated in the following:

51) *Here's the big picture, your capillaries, your capillaries, has fluid exchange, you have fluid going out of your capillary beds. Where are your capillaries? You have them in your hand in your foot, you have them everywhere. You're absolutely right. They're in your feet, they're in your legs, in your brain, they're everywhere. Fluid exchange happens in the capillaries.*

52) *Antigens, pathogens, what an antigen is, is something that can cause your immune response to turn on. Something that can stimulate your immune response. Something that can trigger it, turn it on. Your immune response isn't on until something triggers it to turn it on, so.*

53) *And antigens....my blood is potentially an antigen to you. If my blood was given to you, you might have an immune response to it, so it's a potential immune response.*

Another interesting syntactic device was the use of the superlative to modify the class, as below:

32) *Immunology is probably the fastest growing area of human biology right now, and it's linked in with the lymphatic system*

Here it is possible to see that the use of the superlative creates a single-membered class; therefore, there is no need for distinguishing characteristics to separate it from other members of the class.

Example 32 (above) also demonstrates the use of 'probably' within a definition. Formally speaking, this would mean that the speaker is unsure of the statement he has made, and therefore it is not truly defining the term but only explaining what he believes to be probable. This causes problems for the researcher, as well as the student, because it is impossible to know whether or not the lecturer intended to define the term, or simply elaborate somehow. It would be useful to research how and when the adverb "probably" occurs in lectures, and its effect on the surrounding context.

Another interesting syntactic structure is the "pseudo-cleft (AKA a WH-cleft or a thematic equative), a focus construction in which the wh-clause

functions as subject of the following verb, creating a blatant given-new information structure" (Dr. George Yule, personal email communication 5/6/98). It is shown in the following examples:

52) *what an antigen is, is something that can cause your immune response to turn on....*

54) *what your immune system does, is it scoops out these MHC proteins and if it recognizes them, it leaves them alone...*

B. Lexical Signals

In the U of M data, roughly 11% of the definitions include what Flowerdew considers "clear lexical signals" like *we call / is called / are called / called, mean(s), known as, that is, or define(d)* (p.212). Four definitions (6% of total corpus) include the word "call" as a lexical signal. Three (5% of the total corpus) use "means" as a lexical signal. The lexical signals "defined", "known as" and "that is" do not occur in the data.

A number of other lexical items occur in the data, which may possibly be interpreted as signals. They include:

57) *immune system ... it has something to do with disease...(+ functional definition)*

58) *Spleens are associated with fighting infection, but the common one is destroying red blood cells.*

59) *We're just going to say it's immunological, it's going to fight diseases.*

60) *we do have T Cells and that stands for thymus.*

61) *tropical countries. You know, the countries that are...*

46) *molecular immunologist. You know a person who works...*

62) *hysto, hysto has to do with tissues like hystology*

Also, dummy classes were accompanied by a type of lexical signal ("the name of"), as shown in example 27, 28, and 29, on page 28.

Examples 57, 59, and 61 (all above) bring to question whether the speaker is defining the nouns, or the adjectives which modify them. System and country are probably easy for most listeners to understand; in these contexts the lecturer may be trying to explain what immune, immunological and tropical are rather than the nouns which they modify. One question is, how are adjectives (words which describe a noun or pronoun) defined? This is an interesting concept which would be a valuable topic for another research study.

4. What particular rhetorical features accompany the definitions?

In the U of M corpus, grounders and confirmatory utterances accompanied the definitions. Twenty-two grounders (utterances signaling a definition is to come) were found. Among those are the following examples:

48) *Auto-immune disease, that's the next word I want you to write down.*
(+ definition of auto-immune disease)

63) *Raise your hand if you've heard of elephantiasis...*(+ definition of elephantiasis)

64) *I want you to know that* (+ definition of spleen)

51) *Here's the big picture, your capillaries ...*(+ definition of capillaries)

Seven confirmatory utterances (utterances signaling that a definition just occurred) were found in the data, although they are not as overt as the grounders exemplified above. They include:

-using a discourse marker and then summarizing

65) *(definition of capillaries)...the big point (stressed) is that there's more fluid going out than coming back in the capillary beds...*

- using the term in different word forms

50) *What's that called? SR: Rejection Rejection, your body is rejecting the kidney, your body is rejecting the heart.*

-overtly rewording the definition

66) *(definition of self and non-self)... I'm going to say that again, that's important...(definition of self and non-self)*

As mentioned previously, questions played an interesting role in the lecture. Some definitions were structured around a question and answer series. Also, many definitions were grounded or confirmed with questions. As in Flowerdew's data, "both rhetorical and elicitation questions have the function again of signaling the impending definition and making it stand out from the discourse as a whole" (214). 28 of the 64 definitions were accompanied by some type of question; the questions occurred before, during, and after the definitions.

Ten definitions were preceded by questions asked by the lecturer, and 1 was preceded by a question asked by a student. Those asked by the lecturer include:

1) *what the heck is lymph? If you had a glass of lymph, what would that look like? (+ definition of lymph)*

34) *What does a spleen do? (+ definition of spleen)*

42) *Phago, what does that word mean? Eat*

67) *The lymphatic system, what the heck does it do? Does anybody know?...(+ definition of lymphatic system)*

68) *Well how in the world does immunology and your body fighting disease come into it, well lymph nodes. (+ definition of lymph nodes)*

Ten definitions were followed by questions; however, these questions seemed to fulfill the purpose of elaborating or giving more context rather than confirming the definition.

22) *(definition of pharmacologist)... what would be the hormone that you would most want to make?*

69) *(definition of major lymphatic organs, one of which is the spleen)... Can you live without a spleen? Ever heard of a ruptured spleen?*

70) *(definition of elephantiasis)... What are some organs you've heard elephantiasis in?*

71) *(definition of pathogen)... so are all antigens pathogens?*

In the U of M data, only two of the definitions contained repetition where a whole part of the definition was repeated.

39) *the general term for swelling is edema. The general word for swelling is edema.*

72) *Self, non-self, what belongs, what doesn't belong. If it doesn't belong, how are we going to get rid of it? I'm going to say that again, that's important. What belongs, what doesn't belong? If it doesn't belong, how are we going to get rid of it? What are you going to do with it? Well, self and non-self.*

One facet of repetition that was noticed was the reiteration of the term being defined. During a definition, the term was often repeated up to five times.

73) **lymph nodes.** *Lymph nodes, you have lymph nodes like up in your neck, you know you go in and see (...analogy)... Well these lymph nodes, these are a site where lymph gets filtered, it's a filtering system. A lymph node is a filter.*

Despite the low amount of direct repetition of whole or parts of definitions in the physiology lecture, the reader should not come to the conclusion that this lecturer was not repetitive. The fact that 8 terms were defined more than once, and many formal and informal definitions were accompanied by substitutions,

should demonstrate that the lecturer did build redundancy into his lecture. This redundancy was simply not as clear as repetition of statements. Redundancy in lectures is of great interest, and research in this area of lecture structure would prove useful.

Left dislocation, "where a pronoun is placed after a term, in order to establish it [the noun] as 'old' or 'given' information" (Flowerdew 1991a: 214) occurs throughout the U of M data. 16% of the definitions contained left dislocation, including the following:

73) *Well these lymph nodes, these are a sight where lymph gets filtered, it's a filtering system. A lymph node is a filter.*

74) *bacillus anthrax, that's the name of the organism that causes it*

75) *Auto-immune diseases, these aren't caused by bacteria...*

76) *Miastimia gravis, we have mentioned in this class, it attacks...*

6. Summary of Results

In summary, the U of M data showed the following results.

- **Frequency:** One definition occurred roughly once every 55 seconds.
- **Form:** The definitions were categorized into four types: Formal, Semi-formal, Substitution, and Ostension. The formal definitions were in turn classified into four semantic categories (behavior / process / function, composition, location / occurrence, and attribute / property), and sometimes contained a dummy class. Two-thirds of the formal definition were ordered with the term coming before the class and characteristics. Semi-formal definitions were also predominantly ordered with the term coming before the characteristics. They were categorized into the following semantic categories: behavior / process / function, location, attribute/property, example, and appearance. Formal and Semi-formal definitions were sometimes

accompanied by a substitutional definition; fourteen terms were defined solely by substitution. Six terms were defined ostensively.

- **Linguistic Signals:** The definitions contained several syntactic and lexical devices. The major syntactic signals were the use of the copula, relative clause, the use of the negative while defining, and defining by means of a question-answer series. Other syntactic signals include the use of the second-person singular, the superlative, and the pseudo-cleft while defining. Lexical signals were not common and only accompanied 11% of the definitions.
- **Rhetorical Features:** Twenty-two of the definitions contained a grounder, and 7 contained confirmatory utterances. Other rhetorical devices included the use of questions, repetition, and left dislocation.

7. Discussion

When comparing the Sultan Qaboos University study to the University of Minnesota study, there are several noticeable findings. The frequency of definitions within the U of M physiology lecture was remarkably higher than the average frequency of definitions collected from the lectures at Sultan Qaboos University. The lecturer at U of M supplied definitions about twice as often as the average of the SQU corpus. Even when compared to the SQU lecturer with the highest frequency (1 definition every 1 minute 11 seconds), in the U of M data definitions are still considerably (15 seconds) more frequent. Why was this so? This difference in frequency could be due to a number of reasons including a broader use of the term definition in the present study, physiology course content, lecture style, rate of speech, the lecturer's dialect of English, and other undetermined variables. As discussed previously, the frequency of definition could also be subject matter related (see page 15). Another possibility is that there is a higher frequency of definitions in scientific lectures delivered to an

audience dominated by NS listeners as opposed to audiences composed of NNS listeners.

Concerning the different types of definitions and their distinguishing characteristics, it is impossible to make any generalizations about similarities or differences between present context and the SQU data due to the fact that Flowerdew does not calculate nor compare the different types of definitions within his corpus, nor their semantic order. It is, however, possible to say with the given information that the two situations yielded fairly similar results regarding semantic content.

It appears that the syntactic and lexical signals that occurred in the "specific pedagogic situation" in Oman (1991:203) were different from those used in the one hour lecture given by the lecturer in the midwest region of the United States. Due to the fact that Flowerdew's entire corpus was unavailable for comparison, as well as the fact that the U of M data was limited to one lecture, we must be very cautious here and not make any generalizations. The U.S. physiology lecture did include the copula in a large percentage of the definitions, but several syntactic signals like defining with a question-answer series and defining in negative terms were prevalent in the U.S. physiology lecture, and were not mentioned in the Flowerdew corpus. Also, in the U of M corpus the frequency of the use of lexical signals was remarkably lower (occurred in 11% of the definitions) than in the Flowerdew corpus (occurred in 50% of the definitions); this constitutes a major difference between the two corpora. Several lexical signals like the use of "you", use of the superlative, and use of the pseudo-cleft were noticed in the U of M corpus and not mentioned in the Flowerdew corpus. In order to gain a better understanding of the syntactic and lexical elements typical of defining in a North American

university setting, it is necessary to conduct a more thorough analysis of a larger pool of data.

Concerning the rhetorical features that accompanied the definitions, peripheral utterances (grounders and confirmatory utterances) were found to exist in both corpuses. Because Flowerdew does not include any data concerning their frequency, it is not possible to make any comparisons in this manner. The confirmatory utterances in the U of M data seem to serve the purpose of supplying more context for the definition rather than signaling that a definition has been made. Concerning redundancy, according to Flowerdew, "a whole or part of a definition is often repeated". In the U of M data, this did not hold true. The lecturer did, however, use other methods of redundancy. Also, as mentioned earlier, questions seemed to play an important role in the lecture and often accompanied definitions. The role of these questions is of great interest, and a more thorough analysis of their purpose within the STE lecture would be considerably useful for finding out exactly what role these questions play.

8. Limitations of Study

Because Flowerdew did not publish the criteria he used when extracting definitions from the science lectures at SQU, a major limitation of this study is that it is possible that the two corpuses differ in content, therefore making a comparison of the Flowerdew and Mackey findings to be of little merit.

It is also very important to keep in mind that although Flowerdew's data was limited to his specific pedagogic situation, the corpus involved in the present study is even more limited. Only one hour of one course given by one North American lecturer has been analyzed. It is very possible that this lecturer

defines at an idiosyncratically fast rate compared to other professors in the field of biology.

Another limitation of the study is the context from which the corpus was taken - General College at the University of Minnesota. Because General College admits students who would otherwise not be eligible for university entrance, it is possible that the instructor was over-simplifying his language, or building in structures to assure that his students understood his lecture. This course was attended by students who were not (yet) biology or science majors; it is, therefore, possible that the lecturer was "talking down" to the students for accommodation purposes, and the content may not be similar to that found in lectures given to students who are science majors.

9. Research Implications

In order to gain a better understanding of what actually is representative of the NS lecture, more research needs to be done in U.S. settings, with a greater variety of course types and lecturers. Flowerdew and other researchers at SQU have pioneered and made great contributions to the area of spoken definitions given in EFL settings; however, the generalizations that Flowerdew makes are based on too narrow of a data set. We need more comprehensive studies conducted in the United States and abroad in a variety of scientific settings in order to better understand the speech act of defining in scientific lectures, and to find out if we truly can draw similar conclusions concerning this speech act in L1 and L2 settings.

In addition to learning about the form, function, linguistic devices, and rhetorical features of spoken definitions, research concerning specific aspects of defining (like the use of the negative, the question and answer series, the use

of probably, the relationship between course content and frequency of definitions, and how adjectives are defined) would be considerably valuable.

10. Pedagogical Applications for the EAP Curriculum

When choosing or creating ESL course content, it is of utmost importance on the part of the teacher to make the effort to find out the specific needs of the students, and the real life situations to which they could apply what they learn in an ESL course.

There has been a tendency for teachers and curriculum designers, especially of "general" English classes, to "intuit" the needs and future language uses of students, rather than to attempt to discover them Instead of guessing at student needs. . . we must constantly develop new techniques for examining the tasks students have to perform in English, for understanding the target situations in which they will operate, for analyzing the discourse of target situations (Johns 1991 p. 72).

Rather than intuiting factors concerning the target situation of the scientific lecture, the results and methods of this research could be used to increase the awareness of both NS lecturers and NNS students and begin to create a better understanding of this target situation. Information regarding the way that NS lecturers define in a U.S. setting could prove helpful in training programs for lecturers at institutions of higher education which have a linguistically diverse student population. The issue of such training programs for lecturers dealing with these populations has been raised by Lynch (1994). Due to my current position as a teacher of ESL, my interest and capabilities lie mainly in the training of the student, rather than the lecturer. Thus, this application section will focus on ESL students - specifically those students involved in the English for Science and Technology course at the University of Minnesota described in the introduction of this paper.

Retracing my own efforts to empower my EST students to better understand written definitions, my methods (which included a pair work assignment finding definitions in a technical journal article) seem a bit awkward at best. I was unable to even begin to scratch the surface of the concept of spoken definition, and was unable to impart much advice of great value to my students. Now, with a more refined understanding of written definition in real life scientific and technical contexts, and the results of my analysis of a limited corpus of spoken definitions, there are several steps that I would take to present the function of defining in a more organized and productive manner. To enable students to call upon their own experiences and apply new information to their respective fields, I would include discourse analysis of field specific materials by the student. Drawing upon the work of Littlejohn and Windeatt (1989), the materials used in a course like EST should among other things involve the learners' specialized knowledge, help develop cognitive abilities, promote strategic competence, and help the students "learn to learn" (174). Keeping this, as well as my past experience, in mind, the following lesson was devised.

The first step in helping the students to understand the concept of definition would be to survey students in order to find out which type of reading texts they are most frequently required to read in their specific major. A beginning agriculture student, for example, may be required to read mainly textbooks, whereas an astronomy student may be required to read research articles more frequently than texts. Of course, these reading demands will vary due to the major, level, instructors, and countless other variables. For those new to a major, or not actively involved in a university program, finding out this information may require a bit of investigation on the part of the student in order to discover which types of texts exist, and which are most widely required as reading for their desired program. This investigation may include interviewing

an instructor and / or student members of the desired program. After students have completed this step, they would be asked to bring in an article or chapter from the genre they are required to (or would be required to) read most frequently.

To demonstrate the concept of genre analysis, the students would be assigned to read a section of the chapter on the lymphatic system from the textbook that was used in the Human Anatomy and Physiology course (from which a lecture was analyzed earlier in this paper). In pairs, students would highlight all of the definitions that occur in the text, and in small groups they could come up with a list of conclusions concerning the format, function, and location of the definitions in the physiology text.

Using the articles which the students brought in, each student would be asked to complete an analysis of the definitions that occur in the given context, and create a list of conclusions concerning the format, function, and location of definitions within their program-specific text. A comparison could be made of the definitions found in the physiology reading and those found in other fields, possibly creating a chart or other visual aid.

Because the students are already familiar with the lymphatic system (they read the chapter from the physiology textbook), excerpts from the recorded lecture concerning the lymphatic system could be used in class to increase awareness of some of the possible formats of spoken definitions in a physiology lecture. For example, the teacher could play an excerpt from the lecture (possibly accompanied by a tapescript) which contains a definition for a specific term. Students could compare the spoken definition to the definition found in the physiology text, if for that matter the definition occurs in the text. In addition, a number of discrete point listening tasks could also be created, as well as tasks which guide students to pay attention to intonation and word stress. Students

could also examine the tapescript to draw conclusions concerning lexical and rhetorical signals.

With these tools in hand and ideas in mind, students could then take the analysis of the physiology lecture and apply it to their own classwork and lecture participation. It is common for students to record lectures for review purposes; this lesson could create a structure for NNS students to follow when reviewing their own lectures.

11. Conclusion

The purpose of this study was to give more attention to an academic listening context in the United States that has not been sufficiently explored, and to begin to get a better understanding of one aspect of this context. After a review of the literature as a basis for written and spoken definitions in Scientific and Technical English, questions concerning the linguistic features of definitions found in a physiology lecture at the University of Minnesota were posed and explored. The results, along with the results of Flowerdew, were compared and discussed; the description of the definitions in the SQU setting was not 100% compatible with the description of the definitions provided in the U of M lecture. Issues were then raised concerning the use of EFL data for syllabus design in ESL settings, and a word of caution was given to those who may want apply the generalizations of Flowerdew to their ESL classroom content. The limitations of the Mackey study were discussed, including the small amount of data that was analyzed, the research context of General College, and the possible difference in the interpretation of the term "definition" on the part of Flowerdew and Mackey. A call for future research in more varied L1 and L2 contexts was made in order to gain a better understanding of defining in STE lectures.

From this brief exploration of a University of Minnesota General College physiology lecture, the research suggests that ESL teachers should exercise caution when applying Flowerdew's findings concerning definitions given in science lectures to NNS's. However, it is important to keep in mind that just as Flowerdew's research was based on a narrow data set (EFL only), the present research is simply based on too little data and no generalizations concerning definitions in science lectures can be drawn from it. We still do not know what generalizations can be made concerning definitions in scientific lectures; much more extensive research in a variety of settings must be done before we can confidently do this.

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Appendix A:

The following appendix contains the utterances from the University of Minnesota Anatomy and Physiology lecture which were classified as definitions in the preceding analysis. Each definition is preceded by a number. The numbers on the left and right sides of the colon represent the page number and the line of the original lecture transcript, respectively.

2:13 Endocrinology, pretend you are a **pharmacologist**, that's the person who invents or designs drugs, a person who makes enough drugs to specialize in designing novel hormones, what would be the hormone that you would most want to make?

3:5 not many of you put down the **lymphatic system**. It's not a very popular system, like bones and muscles. The lymphatic system, what the heck does it do? Does anybody know?...It's part, an overview, they stick the immune system in there, it has something to do with disease [instructor then goes off topic]...The job of the lymphatic system is to return the excess fluid. To return the excess fluid to the circulatory system

3:9 Here's the big picture, your **capillaries**, your capillaries, has fluid exchange, you have fluid going out of your capillary beds. Where are your capillaries? You have them in your hand in your foot, you have them everywhere. You're absolutely right. They're in your feet, they're in your legs, in your brain, they're everywhere. Fluid exchange happens in the capillaries. We have fluid going on out and we have fluid going back in. the big point

3:13 **Fluid exchange** happens in the capillaries. We have fluid going on out and we have fluid going back in.

3:18 And over time, if that was true, you would eventually swell up like a balloon because more would go out than come back in and swelling, the general term for swelling is **edema**. The general word for swelling is edema.

3:24 Now let's look at something on page 242, 424. I think it's 424, 424, figure 61 shows you a picture of a **heart**, of arteries, veins and capillary beds. And then the GREEN (stressed) stuff, the lymphatic system is typically shown in green and yellow. The green stuff starts at the capillary beds and then it shows you lymph flow

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3:24) Now let's look at something on page 242, 424. I think it's 424, 424, figure 61 shows you a picture of a heart, of arteries, veins and capillary beds. And then the GREEN (stressed) stuff, the **lymphatic system** is typically shown in green and yellow. The green stuff starts at the capillary beds and then it shows you lymph flow

4:1 Now there is all sorts of **body fluids**, there's saliva, there's blood, there's all sorts of juices associated with reproductive organs then the one you don't really hear about is the lymph. You know even we saw some in the eyes, didn't we?

4:4 what the heck is **lymph**? If you had a glass of lymph, what would that look like? It is very similar to blood, but there's no red blood cells, red blood cells can't get in there. It's even closer to plasma. Lymph is very close to plasma, in composition. And lymph flows through these lymph vessels and then gets drained back into the circulatory system, right around the heart, so it's a drainage system.

4:8 so it's a drainage system, what's the **lymphatic system**? It's a drainage system. It picks up the excess stuff and drains it back into the blood.

4:10 Well how in the world does immunology and your body fighting disease come into it, well **lymph nodes**. Lymph nodes, you have lymph nodes like up in your neck, you know you go in and see (analogy)...Well these lymph nodes, these are a sight where lymph gets filtered, it's a filtering system. A lymph node is a filter.

12) We have some lymph organs too, let's see what we've got. You have lymph. Is lymph a solid, liquid, or gas? Liquid, what's it most like?...Plasma. Plasma. What color do you think it might be?...Clear. Clear, mostly water, it's going to be clear, there's white blood cells in there. Any red blood cells?

5:12 426. 426 is showing you a picture of all these different **lymph nodes**. And main lymphatic ducts. And ah, it's like when you go to see someone to check out if you got an infection. They'll feel here, (points to neck) and they'll feel underneath your arm and they are looking for the popular sites for lymph nodes.

5:17 Spleen, thymus, tonsils, these are the **major lymphatic organs**. Can you live without a spleen? Ever heard of a ruptured spleen?

5:22 What does a **spleen** do? SR: It's not a bone, is it? TR: No it's not a bone...no. Spleens are associated with fighting infection, but the common one is destroying red blood cells. When red blood cells get too old, they're gone, they have got to get destroyed somehow and so your spleen is responsible for chewing up red blood cells, recycling them.

6:7 But your **tonsils**, you know in your mouth let's see if you have a picture of tonsils, (teacher looks in course book)...Adenoids, pharyngeal, ...they're not going to show you the tonsils.

6:22 SQ: Inaudible student question about the spleen). **Spleen** destroys red blood cells. Let's take a peek, take a peek in the book, spleen page 429. Largest of the lymphatic organs that is located in the upper left portion; resembles the large lymph node and subdivided within the lobule spleen tissue, called pulp, red pulp.

6:27 We're just going to say it's immunological, it's going to fight diseases.

7:2 I want you to know that the **spleen** destroys red blood cells.

7:3 thymus, the first letter is important because we are eventually going to talk about T Cells. T cells the T is thymus. I don't have any S cells for spleen, but we do have T Cells and that stands for thymus.....now....edema

7:6 Now...edema (points at board)///good case of edema, ever seen... (pregnancy analogy), it's a lymphatic thing, things aren't draining quite right things aren't draining quite right, there's more fluid out than coming back in and the lymphatic system is not doing its job well enough to get it back in circulation, you know to get it back into the into the system

7:14 Raise your hand if you've heard of **elephantiasis**,,,,yap, two thirds....Elephantiasis is not a disease that you will find in Minnesota, It is a disease that you will find in many, many many tropical countries.

7:14 Raise your hand if you've heard of elephantiasis,,,yap, two thirds....Elephantiasis is not a disease that you will find in Minnesota, It is a disease that you will find in many, many many **tropical countries**. You know, the countries that are between the Tropic of Cancer and the Tropic of Capricorn, where it's warm.

7:18 it's [elephantiasis] caused by a worm called a **phalarial worm** and this worm if it gets inside your body and it wants to live its life or it will live its life in a lymphatic duct. You know, in a duct. It will cut off the lymph flow

7:22 **Elephantiasis** means your organs, or your limbs, or whatever, begins to look more like an elephant than it does a human. What are some organs you've heard elephantiasis in?

8:2 in **elephantiasis** an organ can swell up to 10 times its original size SQ: Is it reversible?

8:13 **Immunology** is probably the fastest growing area of human biology right now, and it's linked in with the lymphatic system because the lymphatic system is where you typically think about your body fighting off diseases.

8:17 You really don't have an immune system, at least it hasn't been classified as that yet, you have a **lymphatic system** and a part, a part of the lymphatic's job is immunology

8:20 And right now there is nothing more marketable in the United States that I know of, as far as biology, than a **molecular immunologist**. You know a person who works on how people fight diseases on a molecular level, that's where the action is.

9:15 Antigens, pathogens, what an **antigen** is, is something that can cause your immune response to turn on. Something that can stimulate your immune response. Something that can trigger it, turn it on. Your immune response isn't on until something triggers it to turn it on, so...

9:18 for example do you want a transplanted heart to be considered an antigen? Someone gets a **heart transplant** that means the heart came from somebody else, you want your body to fight that organ?

9:21 Someone gets a heart transplant that means the heart came from somebody else, you want your body to fight that organ? Is it possible that it will? What's that called? SR: **Rejection** Rejection, your body is rejecting the kidney, your body is rejecting the heart.

9:22 so when someone gets a transplant, they are moved to a very clean room and given lots of drugs called **immunosuppressant drugs**, that push down the immune system.

10:3 **Pathogens** are things that cause disease, pathos, so are all antigens pathogens?

11:2 the first one says anthrax, you look across, then it says **bacillus anthrax**, that's the name of the organism that causes it [anthrax].

11:4 Now there are a lot of diseases in humans that are not caused by organisms, like Huntington's, that's a **genetic disease**.

11:11 well it's under protozoan, the second one up from uh, the bottom, **kala azar**, kala azar (referring to table of diseases and agents in student study guide.) That kills thousands of people a year, but we don't hear about it, because a person dying from kala azar in India doesn't make news because there are so many of them dying of Kala Azar.

11:21 How do you know? Well see that word **protozoans**, that's the name of a, that's the general name of the critter that causes it, trypanosome brucei brucei, is actually the name of thing that causes the worst form. You would know that by having the symptoms.

11:21 Well see that word protozoans, that's the name of a, that's the general name of the critter that causes it, **trypanosome brucei brucei**, is actually the name of thing that causes the worst form.

12:19 How does your body fight diseases in a non-specific way? Well, without a doubt the number one tool to help you fight disease, is....what?....(inaudible student answer) No, non-specific, the most superficial organ in you body, (student replies "skin") **skin** your skin is a very nice variant.

13:14 **Interferon**, that was supposed to be the wonder drug of the early 80's. Interferon, is kind of a big warning, it's a chemical that's sent from one cell to the next, it's supposed to be a big warning that viruses are around, but it helps prevent viral infections, and inflammation.

13:19 **Phagocytosis** I put over here too, (writes on board) Phagos, Phago, what does that word mean? Eat

13:20 **Phagocytosis** is one cell eating another, you have two big phagocytes,

13:20 you have two big **phagocytes**, neutrophils and monocytes, (writes on board). These two are both white blood cells they should sound semi-familiar, in that they are, you know they're [there are] five types of white blood cells, they can eat other cells like pac-mans, and actually if you want to get involved a little deeper there are cells called macrophages.

13:25 What's **macro**? Big

13:25 What's **phage**? Eat

13:25 **Macrophage**, big eater

14:5 But these are **macrophages**, or phagocytosis, things that do the phagocytosis thing. Eat another cell.

14:13 **Self**, non-self, what belongs, what doesn't belong. If it doesn't belong, how are we going to get rid of it? I'm going to say that again, that's important. What belongs, what doesn't belong? If it doesn't belong, how are we going to get rid of it? What are you going to do with it? Well, self and non-self.

14:13 **Self**, **non-self**, what belongs, what doesn't belong. If it doesn't belong, how are we going to get rid of it? I'm going to say that again, that's important. What belongs, what doesn't belong? If it doesn't belong, how are we going to get rid of it? What are you going to do with it? Well, self and non-self.

14:27 So how do you do this? Well a typical cell will have **receptors**. (Writes on board.) Self and non-self is really a receptor game. Proteins on the membrane (Draws, writes on board)

15:2 You're going to get what is called (draws and writes on the board) HL no, no, **MHC proteins**, major histocompatibility. Something like that MHC proteins

15:3 MHC proteins, major hysto, **hysto** has to do with tissues like hystology, are my tissues compatible with that person's?

15:6 are my tissues compatible with that person's? **Hystocompatibility**, tissue companionship, are they going to get along with each other? Major histocompatibility, and I think the C is 'complex'

15:10 And what your **immune system** does, is it scoops out these MHC proteins and if it recognizes them, it leaves them alone, that's how you tell self, non-self proteins, is by these proteins.

15:15 If you want to get a bit more specific, (writes on board), you have **HLA**, human leukocyte antigens. Leukocytes are white blood cells. And antigens....my blood is potentially an antigen to you. If my blood was given to you, you might have an immune response to it, so it's a potential immune response.

15:15 If you want to get a bit more specific, (writes on board), you have HLA, human leukocyte antigens. **Leukocytes** are white blood cells. And antigens....my blood is potentially an antigen to you. If my blood was given to you, you might have an immune response to it, so it's a potential immune response.

15:15 If you want to get a bit more specific, (writes on board), you have HLA, human leukocyte antigens. Leukocytes are white blood cells. And **antigens** (antigen?)....my blood is potentially an antigen to you. If my blood was given to you, you might have an immune response to it, so it's a potential immune response.

15:22 Who's your ideal donor? (followed by variety of student responses) clones, or **twins**, are identical, they have the same everything

16:12 All right, we are almost to a break. **Auto-immune disease**, that's the next word I want you to write down. Auto-immune diseases, these aren't caused by bacteria, by fungus, they aren't caused by some germ. Auto-immune diseases are caused by your immune system having an identity crisis. Your immune system attacking itself.

16:20 [talking about auto-immune diseases] **Myasthenia gravis**, we have mentioned in this class, it attacks the receptors of the motor endplate.

Appendix B:

The following appendix contains the list of field names which were used in the database when analyzing each definition found in the Anatomy and Physiology lecture.

Definition and context

formal

class

dummy class

semiformal

characteristic

substitution

subtype

ostension

syntax

lexical signal

lexical signal type

nominal

embedded

grounder

confirmatory utterance

question

question form

location of question

left dislocation

internal modification

type of modification

reported

repetition