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A STUDY OF COHERENCE: IMPLICATIONS FOR TEACHING WRITING IN AN ACADEMIC CONTEXT

A DISSERTATION SUBMITTED TO THE GRADUATE DIVISION OF THE UNIVERSITY OF HAWAII IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF EDUCATION IN CURRICULUM AND INSTRUCTION AUGUST 1979

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ACKNOWLEDGEMENTS

I wish to acknowledge the help given me by the Imi Ho'ola Program of the University of Hawaii School of Medicine, especially Dr. Ben Young, director of the program. His keen interest in both language and people helped make the study possible. I wish to thank Drs. Nancy Lind and Sandra Beasley for allowing me to attend their beautifully prepared lectures, for constructing the writing assignments, and for their conversation and insight. Errors in the material included in the writing samples can be attributed, not to them, but to the students or my possible misreading of the samples. The student subjects of the study worked long and conscientiously, and I thank them for their effort.

I wish to thank Professor Richard Alm of the Department of Curriculum and Instruction for his most generous help and advice.

To the Department of English at the University of Hawaii I extend appreciation for friendship and support on the job during the period of investigation. To my husband, Roderick A. Jacobs, I express thanks for reading the manuscript and making helpful comments, and to the rest of my family appreciation for their patience.
The purpose of the investigation was to study the problems students have in writing coherent prose in an academic context in which the information load is heavy. Part of this purpose was to develop a descriptive tool, or construct, that would make it possible to compare pieces of writing with regard to coherence, one that would take into account the nature of the task and the nature of language, both the syntactic and semantic components of language.

The methods used for the analysis of student essays borrowed heavily from those used by linguists in analyzing the syntactic structure of sentences. Selected essays were examined intensively, sentence by sentence. Component deep structure sentences of each surface sentence were examined for verb type and sentence topic. The semantic/logical links of cause, comparison, and so forth, both within and between sentences, were also noted.

The essays were written by the eleven students enrolled in Biomed 405, an advanced biology course designed under the direction of the University of Hawaii School of Medicine. The course was part of a year-long review program, which aimed to prepare minority and Pacific Island students for admission to the medical school. Sample essays were analyzed in detail for six students, who had varying degrees of success in learning the course content. The essays were written in class and required a synthesis of material learned from lectures and their textbooks.

It was found that coherence in such a writing context could be described in general terms by the notion of predication load. The load
was a measure of the integration carried out by the student writer in the process of writing each sentence. The load became greater as the student combined more and more pieces of information. Pieces of information were defined—roughly speaking—as the deep sentences (or predications) underlying the surface sentences. These predications, classified by semantic type and counted for each surface sentence, provided a measure of the complexity of the task of maintaining coherence. For the biology writing assignments, two types of content predications were required (differentiated by the syntactic character of the verb). Also required were relational predications such as statements (implied or explicit) of cause, specification, comparison, and so on.

Of the six students whose essays were studied in detail, two students had difficulties maintaining coherence. Both had difficulties stemming from problems with the task of integration. When relational information had to be combined with content information, sentences became labored, clumsy, or grammatically incorrect. A common writing strategy was to avoid integration, in which case the essays appeared to have chunks of information. These chunks, though easy to read and generally correct, were not made relevant by the writer to the essay's main idea.

Such results have developmental implications. They suggest that the learning of content information may temporarily interfere with the writer's ability to maintain coherence. In subject matter courses, where both new information and coherence in writing are important for instructional goals, writing assignments can be modified so as to take
into account these developmental difficulties. The assignments them­selves can be written so as to impose either high or low predication loads. Samples of each are provided, together with their suggested use.
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CHAPTER 1

THE PROBLEM: STUDENT WRITING IN THE ACADEMIC CONTEXT

Literacy Skills for Higher Education

The focus of this study is language, language in the education of minority students. It is a study of the writing skills of eleven minority students selected for a pre-medical review program at the University of Hawaii. The study covers writing done for a college-level advanced biology course given in the spring semester of 1979.

The study assumes that:

1) Deficiencies in writing skills have frequently barred minority students from higher education.

2) Minority students are more likely than most to have had less than satisfactory elementary and secondary school training in writing.

3) Minority students should have adequate opportunities to participate in the expensive tax-supported programs of higher education traditionally enjoyed by members of the dominant middle class culture.

4) To provide such opportunities, special admissions programs should be available to minority students. The existence of such programs does not and should not imply any lowering of the standards required for successful completion of university and professional courses.

5) Educators need to learn considerably more about the student experience with writing in these programs. For instance, do writing problems arise from general deficiencies in language skills or from the nature of the content of instruction, or both? How do students use writing to synthesize information provided by the courses?
In some respects, many college freshmen from the mainstream culture of the middle class may be similarly unprepared for the writing of college-level essays and papers. After all, the eleven subjects of the study had already had three years of undergraduate work, including freshman English; they had advantages of age and motivation. The findings of such a study as this one should be relevant also to the writing deficiencies of other students not only in colleges but at other stages of schooling in which writing plays a significant role in making sense of new information.

A common complaint of English department faculty members is that many students, both minority students and others, generally produce correct writing so long as the assignment fits particular discourse types. Their writing is clear, readable, and correct, especially when the form is personal narrative, but the writing becomes confused, tangled, and sometimes incomprehensible when the student writes for an academic assignment. Mina Shaughnessy has argued that there are certain skills that have not been taken note of in the analysis of academic tasks. In the few contrastive studies she did of skilled and unskilled writers doing the same assignment, she noted that there were "hidden features of competency" possessed by the skilled writers, and that these features had to do not with drawing conclusions but with putting together sentences that would convincingly support these conclusions.

The Need for Constructs in the Study of Coherence

The particular writing problem under study here is coherence. The object of the study is to describe coherence in such a way as to
shed light on the way writers mold and combine information—or do not do so—in the way Shaughnessy describes. At present the concept of coherence is vague, and the words commonly used to describe it—order, relationships, and rhetorical structure—are equally vague. Perhaps the most reliable indicators of coherence are descriptions of reader response. In this sense, a piece of writing is coherent when it elicits the response, "I follow you. I see what you mean," and incoherent when it elicits the response, "I see what you're saying here, but what has this got to do with the topic at hand? or with what you just told me above?" The difference between the two responses presumably has to do with the connections, either implied or stated, between an earlier sentence and a later sentence, but what these connections are and how they are established by student writers is not at all clear.

If a student, working with the facts from his biology lecture, is able to pull together various pieces of information so that their relationships are clear, then one wants to say how he has used language to do this. And if he does not succeed in doing so, one wants to say what feature of language was missing or abused, what rule was broken, or what he did not do. One wants to know if the process of relating information has any connection at all with so-called basic grammatical errors or whether language correctness and language coherence are unrelated. In general, one wants conceptual apparatus that will help to explain the special writing problems that students have when they try to write for the subject-matter class and to predict what can be expected in the way of progress toward more coherent writing in this context.
The direct applications of the study to classroom practices are important but must come second. Too many investigations have begun from the premises that everyone knows what writing is and what is needed is knowledge about how to teach it. This one begins with the premises that not enough is known about the information structure of the written text itself. The study is meant to address the need for knowledge about the written product so that investigators of the future can be somewhat more sure than they are now of what kind of writing they have when they have it. The need is for constructs. As one writer has put it, "Researchers can hardly claim that their techniques have 'construct validity' in the absence of a construct."^2

Especially needed are constructs applicable to academic writing. Academic demands make writing more than just a problem of communication but also an arena for struggle between the writer and the complex information with which he is working. When his struggle is successful, the message he intends to convey is understood by the reader. But frequently this message—that part of the writing which comes directly from the writer himself—is lost or obscured in a cloud of information, or the factual material with which the writer works.

What is happening when the student has information but does not know what message he needs to communicate? What does it mean to communicate a message in a piece of writing? These are the problems motivating the investigation although they involve a number of complex issues beyond its scope. The goal attempted here is the elucidation of the difference between writing in which the writer is struggling to convey a needed message and writing in which the writer is still at the
stage of presenting information without regard to message. An important part of the goal is to define what it is that interrupts the flow of message or makes the prose incoherent, and by contrast to define what it is that makes for the continuous flow of message, or coherence in the prose.

Approaches

A developmental approach anticipates that the learning of new skills or concepts may interfere temporarily with skills—such as skill in creating coherent prose—that have been previously learned. The methods of this study indicate such an approach. Writing done by six students selected from the group of eleven will be examined in order to see how the students' ability to communicate a message is related to the new material they are required to deal with.

The approach is also a process approach. It is an examination of samples of written language for the purpose of exploring and defining the writer's experience. Student writing is examined for much the same reasons that investigators of spoken language acquisition look at transcriptions of children's speech. The student essays are samples of language production from which inferences can be drawn as to process, the processes in which the speaker was involved at the moment of communicating.

Such approaches may help to explain why different samples of the writing of a single student often vary in the degree of correctness and coherence manifested. Problems arise both with mechanical matters of grammar and usage (verb agreement, tense inflection, and the lack
of idiomatic sentence structure) and with the communication of the message—if the student indeed knows what kind of message he has been asked to communicate. This study is an attempt to develop certain kinds of constructs—ways to describe coherence that take into account the cognitive demands of the specific writing task. Educators need such constructs if they are to talk productively to each other about student writing. Educators need a way to talk usefully about possible relationships between coherence and grammatical correctness. Finally, they need to have some way to describe in developmental terms coherence itself and the relations of coherence to both grammatical correctness and cognitive complexity. How might the educator, after examining several pieces by one student, be able to locate the student on some developmental scale? The answers to questions like these should be the basis for important understandings of the role of student writing in the process of education. As will be seen, reasonable answers to such questions are not always simple or obvious.
NOTES


CHAPTER 2
A REVIEW OF THE LITERATURE ON
COHERENCE AND STUDENT WRITING

The literature relevant to such a study comes from a variety of sources. These sources include ancient and modern theories of rhetoric, textbooks, investigative research—both case studies and large-scale statistical studies, as well as analytical work on the structure of discourse. This review will look at the relevant literature from three major areas of work. These are research in the composing processes, studies in rhetoric, and studies in linguistics, more particularly, recent work in syntactic analysis. The work on composing and rhetoric has been done mainly by people who teach writing, or work with teachers of writing, and publish in the English teaching journals, whereas the linguistic analyses have ordinarily been done by people who work and teach in university departments of linguistics and publish in technical journals.

Composing Processes

The work of Moffett argues that composing ability is related to children's developing cognitive abilities. Such abilities are in a sense parallel to types of literary or written forms, for the ability to handle dramatic and narrative kinds of speech and writing develops earlier than the ability to use effectively written forms that require deductive or hypothetical kinds of thinking. The sentence form, "it happened" seems easier to handle than the form "it happens," not because the syntax is easier but because the second form requires that the child
think about what is routine, habitual, or general, whereas the first form requires only a retelling of what happened on a single occasion. Moffett's approach, thus, emphasizes a developmental approach to learning that was made convincing by the earlier work of Piaget with regard not just to writing but to all phases of children's learning.

The emphasis on writing as a thinking and cognitive process that ordinarily must begin from a narrative base is also the approach of Macrorie, who has written several widely-used textbooks for college freshmen and a convincingly argued short book for teachers, *Uptought.* Peter Elbow echoes the theme that writing requires a long period of incubation. His short book, *Writing Without Teachers,* emphasizes that writing is, first of all, a tough cognitive problem. Several chapters are devoted to methods for fruitful thinking, for letting ideas "cook" and "grow."

Literature in the area of composing which claims to study this problem in some organized fashion is very recent. There have been, it is true, literary discussions of the creative processes of major literary figures. However, these discussions do not concern themselves with such concepts as coherence or any systematic analysis of the syntax. They deal rather with larger perspectives--incidents in the writer's life which may have stimulated or influenced the writing, the intellectual climate of the time, other writers, and so forth.

The first detailed study of composing processes as we are concerned with them here is that of Emig. This study was an examination of the writing processes of eight gifted twelfth graders over a year, as represented in their compositions and in their own oral descriptions of how
they set about writing, and how they decided what to say. Of particular interest here are insights into the ways student writers view the demand to write about material that they have not adequately internalized. One highly verbal writer, Lynn, when asked to choose a topic, selected the one for which she had a schema already worked out. The choice was between the topic of her grandmother's recent visits and the topic of visitors' reactions to a rather large cardboard Snoopy in her living room. On the topic of her grandmother Lynn had not yet decided how she felt, but the people's reactions to the Snoopy were already categorized and labeled. In Emig's words:

If, according to the writer's perception, the period is curtailed by his own schedule or by others, he usually does not elect to work on a topic or problem he regards as cognitively or psychically complex.6

A later paper (Jacobs and Karliner, 1977)7 focusses on the nature of the cognitive processing of material by a student writer. Based on the analysis of a transcription of a conference between a student writer and her teacher, the authors demonstrate that such cognitive processing can be difficult and time-consuming for students. In this study, a student is shown struggling to explain her personal reaction to Albee's play, *An American Dream*. Her initial incoherence changes, under the social pressures of a dialogue with her instructor, to a final overall grasp of the relation between her experience of Albee's play and her evaluation of the experience. She ends with a coherent statement, but the stops, starts, pauses, and repetitions in her speech reveal her internal struggle to define and digest the experience into a coherent whole.
Mina Shaughnessy's well-known *Errors and Expectations* approaches student writing from a different perspective. Faced with a topic on which they were presumed to have ideas of their own already, college students at the "basic writing" level wrote prose that appeared to be incoherent because the writers hopped quickly from one idea to another without even minimally adequate discussion of each idea. They were referring to ideas, relying perhaps on the reader to fill in any needed details. The students had no lack of ideas, but simply failed to elaborate and extend, to "play out" the ideas in any coherent way. At this very basic level of writing, the ones who succeeded in producing acceptable writing did so, claims Shaughnessy, by using strategies from spoken language, strategies such as the utterance of platitudes, routine affirmations, and personal reverie--devices common in conversational interaction.

In a wide-ranging survey and study of school writing in the United Kingdom, James Britton, Nancy Martin, and others showed what sort of writing was required of pupils by in-school assignments. In their *Writing Across the Curriculum (11-18)* they show that an appalling amount of the writing done in school by children contains no message at all. That is, the writing collected for their study was largely information recorded in composition books for the sake of information. Little was done by the student writers--or expected by the teachers--in the way of imposing on it various sorts of ideas--comparative ideas, judgmental ideas, ideas about why, or what it's good for, or what it's got to do with me.
An examination of writing programs in England by A. Clegg suggests two main currents, one concerned with exercises and drills in writing conventions, the other aiming at fluency and sincerity but with relatively little detailed discussion of cogency and mastery of content in the senses discussed here. As in the United States, the precise nature of whatever composing processes are involved has, as yet, received little attention in Britain.

There has been in the United States, however, a good deal of work on sentence-combining, which is an important contribution to research on composing. Writers in the field of sentence-combining include Kellogg Hunt, Donald R. Bateman and Frank Zidonis, John C. Mellon, and Frank O'Hare. Their primary emphasis is on the manipulation of syntactic forms (such as transforming sentences into relative clauses so as to fit within another sentence) with little discussion of semantic relationships and coherence. Since the emphasis of such work is on the sentence level, it has been argued by Kroll and Schafer that drill on such sentence manipulation may in fact compound the problems students have with coherence by over-focussing on sentence-level errors and paying too little attention to the structure of a text or to the writer's sense of audience. They claim:

There would seem to be an intimate connection between audience sensitivity and coherence, since coherence involves connecting discourse for the benefit of the reader.

Donald Graves, who has written about his classroom experience with composing and sentence revision, claims that:
Valuable though it be, sentence-combining as a composing skill, must be considered a low-level activity, for it requires the learner to deal with only one aspect of the composing process, namely the manipulation of relationships inside the sentence.18

Studies in Rhetoric

Rhetorical studies have tried to come to grips with the notion of coherence. In general, they seek to explain coherence in terms of the requirements of form, genre, semantics, and logic, and the success or failure of writers in meeting such requirements. The writer is expected to define his purpose—to persuade, argue, narrate, explicate, etc.—and then to select certain elements, devices, and expositional strategies, and to reject others, if he is to achieve his goal. He must learn to use certain stylistic devices—repetition or parallel structure, for example—if his writing is to have the desired power and cogency.

Some modern rhetoricians, such as James Kinneavy,19 have adopted the notion "discourse" as a label for all forms of language use, and they seek to define the forms of discourse by showing what characteristics are shared by all forms and what features are specific to particular types. Kinneavy, like earlier rhetoricians, distinguishes varieties of discourse based on their primary aims, the four types, expressive, referential, literary, and persuasive having distinct goals. He then characterizes four modes of discourse—description, narration, classification, and evaluation. Kinneavy is providing here a taxonomy. The taxonomy extends to a general description of stylistic choices but shows little evidence of being able to deal with semantic coherence.
Perhaps the most pervasive characteristic of such work in rhetoric is the emphasis on phenomena beyond the level of the sentence, on larger elements of form and style, and on an apparent lack of interest in the internal structure of sentences.

Nevertheless, the rhetorical tradition has provided the basis for most analytical studies of paragraph coherence. The work of Christensen shows that subordination extends beyond the level of the sentence and that, in fact, several levels of subordination can exist simultaneously in the paragraph. Aside from his work, most other paragraph analyses in this tradition are efforts to classify subordinate relationships by semantic type: cause-effect/comparison-contrast, generalization-exemplification, definition, classification, and so forth. There are a number of scholars—D'Angelo, Larson, and Winterowd among others—who work within such a framework, although their systems are not used for the study of developing skills.

Lee Odell has argued that the intellectual processes of students can be evaluated by describing the inter-sentence connections by the use of what is essentially this same set of semantic labels. The writer's own handbook (co-authored with R. A. Jacobs) suggests that a similar set of terms can be used by the student for evaluating the connectedness of his own writing. Many textbooks stress the role of rhetorical connections as an aid to the composing process, as well as the phrases such as "consequently," "nevertheless," and "because," which are commonly used to express them. (See especially Arapoff-Cramer's Writing Through Understanding and Lawrence's Writing as a Thinking Process.) There is, as yet, no agreement as to how many
kinds of rhetorical/semantic connections there are or what sort of semantic relationships should be included. But clearly connectors are an important element for the present study. They represent meaning relationships communicated by the writer and understood by the reader and are thus important for any study of coherence.

Linguistic Research

Somewhere between the rhetorical tradition and the linguistic tradition is the work of Kenneth Pike and his collaborators. Pike (1964), and later with R. E. Young and A. L. Becker (1970), argues that sentence structures are related to rhetorical or "presentational" strategies. The speaker first chooses such a strategy—either focus, contrast, classification, context, or change—and then a sentence structure appropriate for the strategy. The manner of Pike's analysis is more characteristic of the rhetorical tradition than that of linguistic studies. This emphasis arises primarily from his emphasis on language as a component of a culture and on the forms used by that culture.

Most studies done by linguists have avoided the rhetorical terminology of contrast, cause, etc. and have generally emphasized the grammar of the sentence. Recent studies, however, have paid much more attention to grammar beyond the level of the sentence. There are four important concepts taken from studies in generative grammar—studies at both the sentence level and beyond the level of the sentence—that are important tools for an investigation of coherence. The four concepts are these:
1. Deep structure sentences
2. Topic and comment
3. Given information
4. Verb features

Deep-Structure sentences. Deep structure is a grammatical construct made relevant to the study of language by Chomsky\textsuperscript{30} and others\textsuperscript{31} in the mid 60s. It allows one to think productively about the way a listener understands a sentence like:

The lamb is too hot to eat.

If the listener pictures a perspiring lamb with no appetite, he has in mind a deep structure like:

The lamb is hot. The lamb cannot eat.

But if the listener envisions a platter of sliced roast lamb, steaming and simmering in rich brown gravy, then he has in mind a deep structure with a different subject:

The lamb is hot. I cannot eat it.

The deep structure is the level at which the significant semantic distinctions are made explicit, the who and the what that are understood by the listener though sometimes only implicit in the final utterance, or the so-called surface structure.

Deep structures in Chomsky's sense are also useful for showing that some simple-looking sentences like:

I want to leave.

are understood as two deep structure propositions--"I want" and "I leave"--of which the second is embedded in the object position of the higher clause. For the sentence:
My arrival surprised her.

the embedded deep-structure proposition "I arrive" has been changed to a noun, or nominalized, so as to fit into the subject slot for the deep-structure sentence, "____________ surprised her."

Gundel (1973) has argued that Chomsky's Aspects model is inadequate because it fails to represent the informational status of the content, i.e., what is assumed by the speaker/writer to be already known to his audience (his "addressee") and what is presumed to be new. Gundel argues for incorporation of the notions of Topic and Comment into any account of the deep structure of a language.

**Topic and comment.** Topic and comment refer respectively to (1) what the sentence is about, and (2) what is said about the topic. The topic of the sentence:

There are more things to do in a city.

would depend on what had been said earlier. Suppose there was a sequence of sentences, like this:

I'd rather live in a city than on a farm.

There are more things to do in a city.

then the topic of the second sentence is a city, because this is what the speaker is talking about:

About a city--there are more things to do in it.

The sentence topic is already established in the discourse or already familiar to the reader. It receives low stress when the sentence is spoken aloud. (The reader is asked to try it again: "There are more things to do in a city.") It is not part of what is being asserted. Rather it is the thing about which the assertion is made.
The topic of a sentence might be "elephants." Then in the sentence:

The most valuable part of the elephant is the ivory tusk.

"elephant" is spoken softly, and the rest of the sentence is given more stress. However, the general topic might be "valuable part," like the skin of the leopard, or the beefsteak of the steer. If so, one reads the sentence differently:

The most valuable part of the elephant is the ivory tusk.

The soft part, or the part not underlined above, is the topic. The topic is not to be confused with grammatical subject, for the topic may or may not be the grammatical subject. It may or may not be near the front of the sentence. It may or may not be explicit.

If "elephants" is an established topic in the discourse, and then one writes:

Hunters have long sought their ivory tusks.

the sentence topic is "their," or more accurately the "elephants" that are referred to by "their." If there are two sentences:

Hunters have long sought their ivory tusks.

To them, these are the most valuable part of the elephant.

then the situation is more complex. Now there are three words in the second sentence--"them," "these," and "elephant"--that refer back to something made familiar by the discourse. But only "these," referring to "tusks," is the topic of the sentence. "Elephant" is familiar because it was established earlier in the discourse. It is an over-arching
topic, either of a paragraph or a longer piece of writing. About the word "them" (meaning "hunters") there could be an argument as to whether it is a sentence topic. Is the speaker speaking about hunters or tusks? The writer makes a statement about tusks, but he also makes a statement (implied rather than explicit) about the values of hunters. There are thus two statements in the second sentence, one that tusks are valuable and another that these are the values of the hunters someone is talking about. Since there are two meanings--the explicit and the implicit--this sentence can be shown as two deep-structure sentences and two topics.

(something) is to the hunters

the tusks are the most valuable

Given information. For Gundel,33 Chafe,34 and others, given information is the term applied to information assumed familiar to the reader. All topics of sentences have the status of given information, and other parts of the sentence may have it as well. The definite article "the" is a common marker of given information, "the" indicating either that the noun it goes with has been mentioned earlier, that the noun is unique (like "the sun" and "the moon"), or that it is being specified in some manner, as by a restrictive modifier, "the man in the gray flannel suit." Verb phrases made into nouns--or nominalized in linguistic terms--have the status of given information, as in "the pumping of blood by the heart."

Since topics are given information, it is interesting to consider, for a study of the connectedness of prose, how the writer connects
sentence topics with information presumed familiar to the reader. The Halliday and Hasan study, *Cohesion in English*, is an exhaustive catalogue of examples classified in various ways so as to characterize the device that links two sentences. Concepts from their study useful for the present one are repetition, pronouns, and what they call lexical cohesion. The first two of these are clearly visible on the surface of sentences. The third is a label for cohesion not visible in surface sentences, though it is important to point out that Halliday and Hasan do not use the notion of deep and surface structure.

Both Halliday and Hasan and Shaughnessy have described one sort of connective device especially useful for writers. They show that the writer who refers to someone or something already mentioned may, in fact, do more than refer. The writer may at the same time apply a characterizing label. The label may express an attitude, as in the example below:

Look at Sally!

The idiot is climbing to the top of the tree.

Or, it may be a means of placing a specific element, such as climbing a tree, in a larger class of acts:

Such an act is reprehensible.

In either case, the author presents the characterization so as to make it seem "given" information.

Verb features. The literature on verb features, as such features relate to coherence, is sketchy. Pedagogical grammars for composition courses have traditionally maintained that the tenses of verbs must be consistent from sentence to sentence, though students wrongly take
this rule to mean that tenses must remain the same. What "consistency" and "inconsistency" really are has not been spelled out by scholarly work.

However, most structural and transformational linguists have concluded that Latin-based descriptions of English verbs--with numbers of tenses, including pluperfect, each tense tightly linked to a particular time frame--are inaccurate. Not only do certain structures such as "will" not always mean what they were thought to mean, in this case the future, but there also appear to be a puzzling number of meanings that can be conveyed by a single form, depending on context. One bit of progress has been to separate "tense" from "aspect" ("aspect" referring to the use of auxiliaries have, will, and so forth, or the progressive -ing), and to separate both tense and aspect from "meaning," or in other words to assume no necessary relationship between meaning and verb forms. Linguists can then proceed from scratch, so to speak, to investigate what relationships actually exist between meaning and verb form.

Work done by such linguists as G. Lakoff and Huddleston in the last fifteen years has established an important distinction between types of verbs, between those that are statal and those that are dynamic. The two verb types have different semantic and syntactic characteristics. Statal verbs--or roughly speaking, those that show states or conditions--are verbs like own, have, or know. Many linguists have noted that these verbs do not behave as verbs are thought to behave. They do not ordinarily take the imperative mode, the progressive aspect, or adverbs of manner. The following, for example, sound strange:
imperative mode: Own a house!
progressive aspect: He is owning a house.
manner adverbial: He owns a house carefully.

The other category or dynamic verbs are the more verb-like verbs, showing action and taking various modifiers, modes, and aspects that verbs are thought to take. Such verbs are take, bring, wear, show, and so forth.

An interesting point made by Huddleston concerns verbs such as locate. This verb (as in "The company has located us here.") is ordinarily dynamic, but in some contexts is statal. Huddleston has shown, in a study of sentences from scientific writing, that some verbs, like locate, have what appears to be a passive form, a feature that would mark it a dynamic verb. But unlike most passives, there is no understood agent, or "by" phrase:

(?) The heart is located in the chest cavity by somebody.

Nor can the verb take a manner adverbial, or the -ing (progressive) form of the verb:

(?) The heart is being located in the chest.
(?) The heart is located carefully in the chest.

These verb phrases are thus statal and not dynamic. Such examples are significant because they show that sentence context is required for making the distinction between verb types. Verbs cannot be categorized out of context.

The work in linguistics reviewed here has been selected for the aid it offers to the methodology of the present study and not for the
insights it offers into the problems of student writers. As an aid to systematic analysis, it is extremely helpful, but for consideration of the relationship between what a writer does and what comes to be produced on the paper, one must look to the other two areas of research reviewed earlier, the literature on composing and studies of rhetoric. These two areas, though less rigorous in analysis, have posed the questions about the writer's struggle with message and material with which this study is concerned.
NOTES


6. Ibid., p. 50.


17 Ibid., p. 229.


27 Mary S. Lawrence, Writing as a Thinking Process (Ann Arbor: University of Michigan Press, 1974).


32 Jeanette Gundel, "Role of Topic and Comment in Linguistic Theory" (Ph.D. dissertation, University of Texas at Austin, 1973).

33 Ibid.

34 Wallace Chafe, Meaning and the Structure of Language (Chicago: University of Chicago, 1970).


36 Ibid., p. 279.

37 Shaughnessy, p. 203.


40 Ibid.
CHAPTER 3
THE SUBJECTS AND METHODOLOGY

The Subjects

The eleven subjects who produced the writing under investigation in this study were participants in the University of Hawaii's Imi Ho'ola Program. The program, federally-funded and administered by the Dean of the Medical School, admits fifteen to twenty students each year for the study of material in the sciences. Of this number several may drop out. The students are selected because they come from communities and cultures under-represented in the medical school and in the practice of medicine generally. The object of the program is to prepare as many of them as possible for admission to medical school.

In the group were five students from Micronesia or Polynesia (two from the Northern Mariana Islands, one from Yap, one from Samoa, and one from Tonga) and six students from families of apparently mixed ancestry in Hawaii. Since being non-Caucasian is not enough to give one minority status in Hawaii, these six were apparently chosen on the basis of other factors, such as the extent to which they genuinely represented communities in need of doctors. Three were part Hawaiian, one came from a largely Portuguese background, one was the son of a Filipino immigrant, and one was ethnically Japanese. The communities they represented were mainly rural rather than urban, three from Oahu, and the others from outlying islands in the Hawaiian chain. Two of these six, the two had graduated from private high schools in Honolulu, were easily the best writers of the whole group of eleven. Their skill
in both grammar and coherence was quite clear in preliminary writing done in the semester before the biology writing began. The writing of these two was quite different from the writing of the other native speakers of English.

Differences between the other native speakers of English and the non-native speakers were not so immediately obvious. Compared with other foreign graduate students on campus, most of the non-native speakers had excellent skill in English grammar. Almost their entire education had been carried out in English. In Micronesia and Polynesia, the high schools ordinarily use English because textbooks are written in this language and because English is the language commonly used for writing. The students had attended U.S. universities, usually for three years. Those readers who have taught English composition to foreign speakers will recognize the following sample, written by a student from Saipan, as quite a competent one:

1) Several body systems are involved in maintaining salt and water balance. 2) These systems, which control the amount of electrolytes and fluid in the body, are crucial for the maintenance and survival of the organism. 3) The two specific systems which will be covered are the exocrine and urinary systems. 4) The exocrine glands are responsible for the secretion of various substances into a duct and then to the external environment. 5) These glands do not pour their contents into the blood vascular system of the organism. 6) Among the complex substances secreted by these glands are water and salt. 7) The two compounds are usually secreted to the external environment when they are bound to other molecules.

Tomas, Essay 12

All of the students in the group had taken a science major in high school and college, though differences in their knowledge of
science may have been an important variable in their ability to write coherently about the topics given for the present study. One student had taken a botany major rather than chemistry or biology. Others may not have had demanding work in their earlier course work. Ideally a study like this one would use a group of subjects nearly identical in their knowledge of the information about which they are asked to write. In fact, if one wants to study writing within an actual academic program rather than in circumstances designed for an experiment, it may be impossible to find students ideally matched.

The students are listed, by fictional first names, in Table 1 according to their success on objective tests of content for the course. On this basis, they rather clearly fall into three groups: a high group, a middle group, and a low group. The table summarizes information about their language, ethnicity, and educational backgrounds.

The Academic Context

The course in which the writing was done was Biology 405, actually called "Biomed 405" because it was taught under the direction of the medical school administration. Information was conveyed through lecture and lab, slides and drawings, as well as assigned reading in three or four detailed textbooks. Two weeks were spent on the muscle system, two on the circulatory, less than a week on the immune system, one on digestion, one on respiration, two on endocrinology, two on the nervous system, two on the urinary system, and one on the reproductive system. The curriculum was designed not only to review systems the students had presumably studied before but also to simulate some of
Table 1  The Subjects Grouped According to Academic Success: Their Language, Ethnicity, and Educational Background

<table>
<thead>
<tr>
<th>Name</th>
<th>Academic Group</th>
<th>First Language</th>
<th>Ethnicity</th>
<th>Educational Background</th>
</tr>
</thead>
<tbody>
<tr>
<td>Richard</td>
<td>High Group</td>
<td>English</td>
<td>Hawaiian/ Japanese</td>
<td>Selective private high school, Honolulu, college in Honolulu, a few years doing other things after college</td>
</tr>
<tr>
<td>Carol</td>
<td></td>
<td>English</td>
<td>Hawaiian</td>
<td>Private high school in Honolulu, mainland college</td>
</tr>
<tr>
<td>Carl</td>
<td></td>
<td>English</td>
<td>Portuguese</td>
<td>Parochial high school, Honolulu, mainland college</td>
</tr>
<tr>
<td>Tomas</td>
<td></td>
<td>Chamorro and Carolinian (Micronesia)</td>
<td>Carolinian (Micronesia)</td>
<td>High school in Micronesia, college in Guam and U.S. mainland</td>
</tr>
<tr>
<td>Rudy</td>
<td>Middle Group</td>
<td>English</td>
<td>Filipino</td>
<td>High school on Maui, mainland college</td>
</tr>
<tr>
<td>Marilyn</td>
<td></td>
<td>English</td>
<td>Japanese</td>
<td>High school on island of Hawaii, college in Honolulu</td>
</tr>
<tr>
<td>Kimberly</td>
<td></td>
<td>English</td>
<td>Hawaiian/ Chinese</td>
<td>Private high school in Honolulu, college in Honolulu</td>
</tr>
<tr>
<td>Raphael</td>
<td>Low Group</td>
<td>Yapese (Micronesia)</td>
<td>Yapese</td>
<td>High school in Micronesia, one year in Washington, D.C., mainland college</td>
</tr>
<tr>
<td>Fatui</td>
<td></td>
<td>Tongan (Polynesian)</td>
<td>Tongan (Polynesian)</td>
<td>High school in Tonga, Honolulu college</td>
</tr>
<tr>
<td>Tua</td>
<td></td>
<td>Samoan (Polynesian)</td>
<td>Samoan (Polynesian)</td>
<td>High school in Samoa, mainland college</td>
</tr>
<tr>
<td>Jesus</td>
<td></td>
<td>Micronesian language</td>
<td>Micronesian</td>
<td>Complete information not available; presumably high school in the Pacific and college on the U.S. mainland.</td>
</tr>
</tbody>
</table>
the frustrating conditions of medical school. In the course, as in medical school, students were faced with a mound of information so large that no one could possibly learn it piecemeal. They were forced into organizing the material, a processing of information that should have begun as the student took in material during lecture and should have been apparent in whatever writing or speaking he did on the subject matter.

The instructors of the course devoted a great deal of time to arranging the material so as to give out the right amount in the right order to help the students learn not just the information but also the skills for organizing it. They saw the weekly writing exercise as an exercise in synthesis. To make the writing function in this way, they worked with the investigator to construct a lead-in sentence each week that would require the students to relate bits and pieces of information from the lectures that had not been explicitly related in the lectures. It was thus intended that the students would have to find ways of relating the information through language. Just as the students presumably used organizing principles to take in material efficiently, they would have to use them for writing. But the nature of the lead-in sentence would require them to use organizing principles different from those that structured the lecture.

Three of the exercises were "second chances" because students wrote on a lead-in sentence they had already used once, though without looking at their first effort. If they had lived with the material a week longer, perhaps they would be more familiar with it and would write about it in a different way.
The lead-in was a kind of essay examination question that set the direction of the essay. (The lead-in sentences, dates, and topics of the relevant lecture material are listed in Table 2.) The students were instructed to use the lead-in sentence as their first sentence and then to continue writing so as to elaborate on it. The material for the essay had been provided in the previous two or three lectures and students were free to examine their notes before writing so as to review the details. Since they were told to write "about" two pages on rather wide-lined paper, the required quantity was not great. Of the hour given for the writing, half of the time could have been spent in thinking and review, and some in fact did this. All of them were motivated to do well on these assignments because the mark on the writing exercise counted toward the mark for the course. The course mark, in turn, was important for admission to the medical school.

As for the role played by this investigator, it was rather like that of a teaching assistant interested mainly in communication skills but working under the supervision of the two professors of the course. In the students' view, the investigator was someone who gave out the writing assignment, answered questions if needed, and graded the papers as an English teacher might, adding comments and encouragement at the bottom of the paper. Such teaching as there was consisted of this response. Each week a carbon copy of what each student had written was put into his student mailbox, together with the comments, also a single dittoed sheet with general remarks to the class, and a sample essay showing how the assignment might have been written. The sample was usually an edited copy of the best essay in the class, sometimes
### Table 2. The Writing Assignments

<table>
<thead>
<tr>
<th>Essay</th>
<th>Date</th>
<th>Topic</th>
<th>Lead-In Sentence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1/26</td>
<td>Muscles</td>
<td>Muscle cells are cells specialized for contraction.</td>
</tr>
<tr>
<td>2</td>
<td>2/2</td>
<td>Muscles</td>
<td>Muscle cells transform chemical bond energy into mechanical work.</td>
</tr>
<tr>
<td>3</td>
<td>2/9</td>
<td>Muscles</td>
<td>Certain characteristics contribute to important differences between cardiac and skeletal muscle.</td>
</tr>
<tr>
<td>4</td>
<td>2/16</td>
<td>Circulation &amp; Muscles</td>
<td>Smooth muscle action affects cardiac output.</td>
</tr>
<tr>
<td>5</td>
<td>3/2</td>
<td>Immune &amp; Digestive</td>
<td>The digestive system has immune system components.</td>
</tr>
<tr>
<td>6</td>
<td>3/9</td>
<td>Respiratory &amp; Digestive</td>
<td>Increased surface area is important for the functioning of both the digestive and respiratory tracts.</td>
</tr>
<tr>
<td>7</td>
<td>3/16</td>
<td>Respiratory</td>
<td>Increased muscular activity increases total pulmonary ventilation.</td>
</tr>
<tr>
<td>8</td>
<td>3/21</td>
<td>Endocrine</td>
<td>A hormone may have more than one target cell and thus regulate more than one kind of activity.</td>
</tr>
<tr>
<td>9</td>
<td>4/6</td>
<td>Endocrine</td>
<td>(second draft of above)</td>
</tr>
<tr>
<td>10</td>
<td>4/13</td>
<td>Endocrine &amp; Nervous</td>
<td>The endocrine and nervous systems can be considered a single control system.</td>
</tr>
<tr>
<td>11</td>
<td>4/20</td>
<td>Endocrine &amp; Nervous</td>
<td>(second draft of above)</td>
</tr>
<tr>
<td>12</td>
<td>4/27</td>
<td>All systems</td>
<td>Several body systems are involved in maintaining salt and water balance.</td>
</tr>
<tr>
<td>13</td>
<td>5/4</td>
<td>All systems</td>
<td>(second draft of above)</td>
</tr>
</tbody>
</table>
a composite of the three best ones. This dittoed sheet also showed the range of grades, allowing the student to compare his own with the others in the class. The general comments stressed the same three criteria for each essay: (1) how well could a reader follow what they were saying? (2) how much relevant detail was included? (3) how correct was the essay in terms of grammar? Student interaction with this investigator also included conversation just before and after the writing exercise and, on one occasion, a session for taping an interview with each student on the subject of organizing information, both for writing and for study purposes. Aside from the strictly academic writing, some of the eleven students sought advice about the writing of applications or letters.

The Selection of Essays for Analysis

The essays of six students were chosen for detailed analysis, two students from the high-scoring group on objective tests, two from the middle group, and two from the low group. A good part of the purpose of the study was to look at the relation between the structure of the essay and academic success. In particular, the purpose was to examine the writing done by students who knew a great deal of material, not necessarily material well organized but at least memorized in some way or other. For this reason, students in the middle group whose study skills were erratic and who sometimes appeared not to know the information were not selected for analysis. For the same reason, those in the low group were studied for purposes of comparison with the others but in less detail because they too appeared not to be in control of
the information. They were clearly motivated to study, but how efficiently they were able to use time, how well they understood the language, how sound their background in science was--none of this was thoroughly investigated. Table 3, which again lists all eleven by groups, summarizes the investigator's impressions of their study skills and control of the information.

From the high group, the two whose essays were selected for analysis were the two who consistently scored highest on tests and had very good control of the information. The two selected from the middle group also seemed to have good control of the information, though the judgment of the course instructors was that their studying was inefficient.

In the analysis of the essays of the six students, the most attention was paid to those written by the three students who seemed to have good control of the information but who also had problems of one kind or another with writing. These included Rudy and Tomas in the middle group, and Carol in the high group. Of the thirteen essays written for the semester, ten were analyzed for each of these students. The writing of the other three students--Richard in the high group, Tua and Jesus in the low group--was analyzed for purposes of comparison with the other three. Five essays were analyzed for each of these.

Methods for Analyzing the Essays

The purpose of the analysis of each piece of written work was to characterize it in terms of general features. There were several features, both grammatical and rhetorical, that were likely to be
Table 3  The Subjects: Their Study Habits, Control of Information, and Grammatical Correctness Before the Course

<table>
<thead>
<tr>
<th>Name</th>
<th>Academic Group</th>
<th>Study Habits</th>
<th>Control of Subject Matter</th>
<th>Correctness (before course)</th>
<th>Writing selected for Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Richard</td>
<td>High Group</td>
<td>good/efficient</td>
<td>good</td>
<td>good</td>
<td>x</td>
</tr>
<tr>
<td>Carol</td>
<td>High Group</td>
<td>good/efficient</td>
<td>good</td>
<td>fair</td>
<td>x</td>
</tr>
<tr>
<td>Carl</td>
<td></td>
<td>good/usually efficient</td>
<td>good</td>
<td>good</td>
<td></td>
</tr>
<tr>
<td>Tomas</td>
<td></td>
<td>good/not efficient</td>
<td>good</td>
<td>fair</td>
<td>x</td>
</tr>
<tr>
<td>Rudy</td>
<td>Middle Group</td>
<td>good/not efficient</td>
<td>good</td>
<td>fair to poor</td>
<td>x</td>
</tr>
<tr>
<td>Marilyn</td>
<td></td>
<td>vacillating</td>
<td>vacillating</td>
<td>excellent</td>
<td></td>
</tr>
<tr>
<td>Kimberly</td>
<td></td>
<td>vacillating</td>
<td>vacillating</td>
<td>excellent</td>
<td></td>
</tr>
<tr>
<td>Raphael</td>
<td></td>
<td>sometimes good/not efficient</td>
<td>poor</td>
<td>fair</td>
<td></td>
</tr>
<tr>
<td>Fatui</td>
<td>Low Group</td>
<td>sometimes good/not known</td>
<td>poor</td>
<td>fair to good</td>
<td></td>
</tr>
<tr>
<td>Tua</td>
<td></td>
<td>good/not known</td>
<td>poor</td>
<td>fair</td>
<td>x</td>
</tr>
<tr>
<td>Jesus</td>
<td></td>
<td>not good/not known</td>
<td>poor</td>
<td>poor</td>
<td>x</td>
</tr>
</tbody>
</table>

*"good" means "put in the time"
important to an explanation of coherence. It was important to look at the data with all of them in mind, and to expect the features to interact with one another.

**Working hypotheses.** Working hypotheses were the following:

1) The method by which a sentence topic was linked to earlier information would be revealing because it would relate to a reader's intuitive judgment of the maturity or complexity of the writing. If a reader felt that the writer was in command of, and aware of, a good deal of information, then perhaps this judgment could be explained in part by the linking between the sentence topic and its referents. Perhaps the sentence topic would frequently refer to nouns or verbs *not* on the surface but in a deep structure (or "understood") sentence. Sentence topics would include nominalizations in the more complex writing, making links with earlier verb phrases or even whole sentences rather than just with simple nouns. In other words, the mature writer would use sentence topics that made reference to large pieces of meaning rather than small ones, with the effect of more "compactness" in the writing, or more density of connection. Writing might make use of the characterizing reference with the same effect, for by using the topic position to convey in given status what was actually new information, his sentence would then convey two assertions rather than one.

Less complex writing would show connective devices between the sentence topic and its referent by simpler means, by pronouns and repetition.

2) A second hypothesis was that an examination of verb type, aspect or tense would reveal some sort of pattern of parallel structure
from sentence to sentence. Since the student writing made use of only one tense—the biology information did not require past or future—and no progressive or perfect aspect, then parallel structure of this kind would show itself only in the use of verb type.

3) A third hypothesis was that each sentence would have a rhetorical function that could be characterized by the traditional labels, cause, comparison, identity, time, significance, condition, and so on. The failure of a sentence to show such a connection to other sentences would indicate a flaw in coherence.

In view of these hypotheses, it was useful as an initial methodology to set out the data grid-fashion in a way that would highlight the patterns being sought. For each sentence the relevant data was the following:

1) the topic
2) the referent of the topic
3) the connective device between the topic and its referent
4) the verb
5) the verb type
6) "connectors" such as time words, "because," "also," etc.
7) the rhetorical link between the sentence and some prior element.

These data were listed crosswise for a single sentence on a wide piece of paper, then the same was done for succeeding sentences. Then one could examine the data for a single sentence by looking crosswise, and could examine the pattern of several sentences by looking up and down the columns, seven columns for the seven pieces of information. The grid layout is illustrated by Tables 4 and 5.
Table 4  **Grid-Style Analysis**

The passage analyzed here is included on page 28 of this chapter.

<table>
<thead>
<tr>
<th>Sentence</th>
<th>Sentence topic</th>
<th>Column 2</th>
<th>Column 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>salt and water balance</td>
<td>general academic context</td>
<td>nominalization</td>
</tr>
<tr>
<td>2 a.</td>
<td>these systems</td>
<td>noun in $S_1$</td>
<td>demonstrative pronoun + repetition</td>
</tr>
<tr>
<td>b.</td>
<td>these systems</td>
<td>noun in $S_1$</td>
<td>demonstrative pronoun + repetition</td>
</tr>
<tr>
<td>3</td>
<td>the systems</td>
<td>noun in $S_1$</td>
<td>determiner + relative clause + repetition</td>
</tr>
<tr>
<td>4</td>
<td>the exocrine glands</td>
<td>noun in $S_3$</td>
<td>repetition + assumed knowledge</td>
</tr>
<tr>
<td>5</td>
<td>these glands</td>
<td>noun in $S_4$</td>
<td>demonstrative pronoun + repetition</td>
</tr>
<tr>
<td>6</td>
<td>these glands</td>
<td>noun in $S_4$</td>
<td>demonstrative pronoun + repetition</td>
</tr>
<tr>
<td>7</td>
<td>the two compounds</td>
<td>nouns in $S_6$</td>
<td>characterizing reference</td>
</tr>
</tbody>
</table>
Table 5  **Grid-Style Analysis** (continued)

The passage analyzed here is included on page 28 of this chapter.

<table>
<thead>
<tr>
<th>Sentence</th>
<th>Verb of clause</th>
<th>Verb type</th>
<th>Connectors</th>
<th>Rhetorical link to earlier sentence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>are involved in</td>
<td>statoal</td>
<td>-----</td>
<td></td>
</tr>
<tr>
<td>2 a.</td>
<td>are</td>
<td>estiloal</td>
<td>-----</td>
<td>Significance of noun in $S_1$</td>
</tr>
<tr>
<td>b.</td>
<td>control</td>
<td>dynamic</td>
<td>-----</td>
<td>Specify $S_1$</td>
</tr>
<tr>
<td>3</td>
<td>are</td>
<td>statoal</td>
<td>-----</td>
<td>Identify noun in $S_1$, $S_2$</td>
</tr>
<tr>
<td>4</td>
<td>are</td>
<td>statoal</td>
<td>-----</td>
<td>Not very clear</td>
</tr>
<tr>
<td>5</td>
<td>pour</td>
<td>dynamic</td>
<td>-----</td>
<td>Not very clear</td>
</tr>
<tr>
<td>6</td>
<td>are</td>
<td>statoal</td>
<td>-----</td>
<td>Not very clear</td>
</tr>
<tr>
<td>7 a.</td>
<td>are secreted</td>
<td>dynamic</td>
<td>-----</td>
<td>Specify $S_1$</td>
</tr>
<tr>
<td>b.</td>
<td>are bound</td>
<td>dynamic</td>
<td>when</td>
<td>Condition of $S_7a$</td>
</tr>
</tbody>
</table>

---

[Image of the page]
The grid style of analysis was a useful preliminary step in this study. It was especially helpful in describing structures of writing that were judged to be irrelevant to the lead-in sentence. The details of this writing are presented in Chapter 4, which discusses primarily the essays of a single student from the middle group and shows how he gradually changed his methods of structuring information, or creating coherence in writing.

The two kinds of verbs. But while such an explanation was useful for describing what was wrong with several pieces of writing, it failed to provide a sufficiently general explanation. It did not explain what was happening in other pieces of writing, especially with the verbs. The preliminary hypothesis that verb type would be the same from sentence to sentence—that statal verbs like are located would not mix with dynamic verbs like flow—was clearly wrong. Only in rather simple styles of coherence did such a parallelism of style occur. Otherwise, the verb type was mixed and not parallel in type from one sentence to the next. In fact, the pattern had to be mixed to meet the demand of the assignment, for the assignment asked students to consider the relationship between dynamic aspects of biology and statal aspects (how the body works and how the body is structured). Coherence therefore did not seem to depend on a parallelism of verb types. For the particular kind of writing the students were required to do, coherent presentation seemed to require both types of verbs, though it was not clear whether both types had to appear in the surface structure or only in the deep structure, or whether any difference arose from the use of one verb type or the other in the main clause or in the subordinate
clause. In any case, the hypothesis that both verb types were required was a helpful one. It explained why some of the material in the very simply structured essays was judged to be irrelevant. In one essay, nineteen sentences in a sequence had no dynamic verbs (in either surface or deep structure), only statal verbs. As the essays for this student became increasingly well-integrated and relevant to the assigned topic, the number of sentences with dynamic verbs increased.

But there were further problems with verbs. The statal verbs presented some difficulties for the analysis because some of them played a larger role in establishing semantic connectedness than did others. There was clearly a qualitative difference between the two sentences:

The heart is cone-shaped.

and

The heart is similar (to something).

Though the verb is the same and both verbs are followed by adjectives, the two sentences have different sorts of predications. The second is relational and connects with another sentence, while the first simply supplies an attribute of the heart. For the purpose of capturing the quality of integration in student writing, it was important to formalize the distinction between the two kinds of sentences. The semantic feature of comparison in the second sentence above would show up in the grid-style analysis in the rhetorical links column as a kind of descriptive label, but how was one to relate this very important point to the rest of the columns, the grammatical elements of the sentence?
The argument for deep structures to represent relational meaning. At this point, several facts and observations seemed to be connected:

1) As just pointed out, some sentences using the same statal verbs are in one case relational in function and in another simply "attributing" in function. (They name a quality or attribute.)

2) In some sentences the content asserted by the main verb may be less important than information elsewhere in the sentence. The function of such main verbs is simply to assert the relationship between pieces of information, which may or may not be presumed familiar to the audience, for instance:

   The Senate's passage of the bill caused
   (or preceded, led to, was related to)
   the riot in the small town.

3) Connectors often labeled adverbs (sometimes "sentence adverbs") or adverbial clauses frequently function as little statements on their own. The sentence:

   For example, influenza is a viral infection.

functions as two statements, one an attributive statement about influenza, and the other a relational statement that the fact about influenza is an example of some generalization expressed earlier. Despite the fact that the phrase for example lacks a verb, the phrase embodies a semantic proposition. The assertion that influenza is a viral infection is itself part of a larger proposition asserting that this fact about influenza is an example of some larger generalization. In the vocabulary of generative-transformational linguistics, the larger proposition
includes the influenza fact within its semantic scope. An account of these "deeper" semantic properties appears essential to any adequate account of coherence.

4) Indeed many sentences seem to require a deeper semantic analysis. One sentence discussed in Chapter 2 (p. 18):

   The ivory tusks were valuable to the hunter.

required a breakdown into two major semantic propositions, one attributive ("the ivory tusks were valuable") and the other relational ("the value of tusks was in relation to the hunter.") It is possible in fact to give a near-paraphrase in which to the hunter has its own clause:

   It was to the hunter that the ivory tusks were valuable.

This kind of analysis is required for semantically based generative-transformational grammars which must include all such semantic information in deep structure.

5) Since the investigation is concerned here with sentences in a connected discourse, other relationships without any overt linguistic marking must be represented. Compare the pairs of sentences in A and B below:

   A. 1. Blood groups can be used to test paternity.
       2. For example, if an O-type mother has a B-type child, the child's father must be B-type.

   B. 1. Blood groups can be used to test paternity.
       2. If an O-type mother has a B-type child, the child's father must be B-type.

Passages A and B are clearly paraphrases. The phrase "for example" in A merely makes explicit a semantic relationship already implicit
in the ordering of the sentences and in the relationship understood between the content of the two sentences in each passage.

Such considerations argue that relations such as cause, comparison, and exemplification are revealingly represented as deep-structure propositions, i.e., deep sentences. Such explicit representation, as stated earlier, occurs in semantically based generative-transformational grammars. To capture such insights it is not necessary to borrow the elaborate machinery of such a grammar. However, this investigator borrows the notion of deep structures and considers relational meaning as if it has syntactic form and must therefore be represented in explicit form. It is therefore no longer necessary to use either the rhetorical links column shown as Column 7 in the grid-style analysis or the "connectors" column. The use of deep-structure sentences allows all such semantic phenomena to be considered as a unitary phenomenon, regardless of the varying surface realizations.

The column analysis of verbs was nevertheless useful in pointing up the distinction between two kinds of content information--information about the structure or state of the body, and information about the dynamics of the body. The assignments given the students required both kinds of information. Students who provided only structure or state information used only statal verbs. Students using both kinds of information had to use both kinds of verbs. Thus the use of both kinds of verbs is one indication of a higher level of writing skills for fulfilling the requirements of the assignment.

Note that the linguistic framework used relates deep structures to surface structures by means of syntactic transformations, processes
which reorganize and often "reduce" the underlying forms. Such reduction is dependent in part on the given or new informational status of the semantic proposition. A writer failing to reduce structure when such reduction is called for may miscommunicate. Some of the best student writers in the group were able to convey both dynamic and statal information either implicitly or by so-called "reduced" forms. Richard, for example, one of the two good writers in the high group, was able to convey a great deal of information in this way. Beginning with the assigned lead-in sentence:

Muscle cells are cells specialized for contraction.

he followed up with

The muscle fibers' contractile units are composed of four types of proteins.

Implicit in this follow-up sentence is the deep-structure statement:

1) The cells have muscle fibers.

Expressed but in reduced forms are these deep-structure statements:

2) The muscle fibers have units.

3) The units are contractile units.

All three are statements of statal information. Number (2) has been reduced to a nominal: "the muscle fibers' units" and (3) to an adjective: "the muscle fibers' contractile units." Number (1) is, of course, not expressed at all since it is implicit.

It seemed reasonable therefore to analyze each surface sentence as a group of predications--roughly speaking, the deep-structure sentences--and then to count them and to label them either as relational or as content, and to label the content predications according to the
types of content--body structure content and body function content. This kind of procedure would capture not only the quantity of relational meaning but also show the extent to which the student had used both types of content. It would serve as a measure of his attempt to integrate different kinds of meaning and to use the one kind of meaning which functions solely to integrate other kinds of meaning.

Further illustration of this method and the results of its application to the biology writing under study are presented in Chapter 5. As shown there, the methodology is a way of defining coherence in terms of relevance to the required writing task. When the information provided by the writer does not meet the expectations of the reader, it is perceived as irrelevant, irrelevance in turn constituting a break in the flow of information. The important questions to ask, then, are "What kinds of information were required by the task? what kinds did the students provide? did their production meet the requirements of the task? how did their early work relate to their later work in this regard?" Chapter 5 argues that the methodology described here can answer these questions. Chapter 5 is necessarily a general chapter, containing descriptions that are formal.

Chapter 4 presents, in depth, a special case of the general findings. It bears out the general point that the information types used by the writer must match in number the types expected by the reader. It shows that writers who do not use the required types may produce passages of the writing that have internal structure of their own but do not advance the assertion made in the lead-in sentence. These passages then are falsely coherent, and the break in message flow is all
the more jolting when the passage is finished and the reader must try to reconstruct the link between the passage and the material surrounding it. Chapter 4 explores in specific detail this particular kind of problem with coherence, drawing heavily on the work of a single student. Whereas Chapter 5 is generalized and formal, Chapter 4 is more specific and anecdotal.
The instructors were Drs. Nancy Lind and Sandra Beasley.

Their stories in themselves were puzzling. The two were young women and though they had the most mature writing skills in the class, they had problems that I believe were connected with confidence and self-esteem as well as conflicting loyalties or ambitions. Three other young women, two of them Samoan, had already dropped out of the program. Their verbal skills were also very good. At least two of these five women had health problems in their immediate families, which demanded their attention. One young man dropped out for a similar reason.
CHAPTER 4
COHERENCE IN THE WRITING OF THE MIDDLE GROUP

Over the period of the semester, there were--from the viewpoint of one who teaches composition--two problems related to the coherence of the student writing. One of these was irrelevance and the other was the lack of detail or texture. Irrelevance caused incoherence because it brought in a line of thought puzzling to the reader, who was prepared for some other line of thought. The lack of detail, strangely enough, made it too easy to be coherent. Some of the students, like those of Mina Shaughnessy (p. 11, this study) sometimes simply spun out a general idea without adding anything that extended it or elaborated on it. Or they left half of the paper blank, in which case the writing that they produced was quite coherent, though shallow and boring. To bring in detail always created the risk that its relevance to the main idea would not be understood, but of course this risk had to be borne. The task, then, was to select enough detail and to show its relevance in a way that would be understood.

On this basis the high, middle, and low groupings showed rather clear differences. Those in the high group handled both detail and relevance quite well; there was detail in quantity and it was admirably organized, though in the case of Carol there were numbers of grammatical errors. Those in the middle group (except one, Marilyn) produced detail in quantity, but the relevance to the main idea was not always clear. Two students, Rudy and Tomas, sometimes introduced whole paragraphs of material that seemed off the point. Of those in the low group, on the
other hand, most wrote relevantly but without detail. These students were referred to above as having too easy a job, for without having to think about a mound of complex information, it was easy enough to write in general terms about the lead-in sentence. Raphael usually fit this description and sometimes—not always—Tua as well. Fatui was an extraordinarily skilled writer, but when he was short of information or did not know how to relate what he knew to the lead-in sentence, he simply left the paper blank. Jesus had neither control of information nor skill in writing coherently, at least on the few samples of writing he produced. Of the group he was the only one not motivated to study a great deal. He frequently did not come to the writing exercise. His writing, unlike the others in the low group, was neither relevant nor coherent.

Generally speaking, the high group had both relevance and detail, the middle group had only detail, and the low group had only relevance.

The group most interesting in terms of writing development over the semester was the middle group. Those in the low group could not really engage in the struggle of message over material because their writing lacked adequate content. Those in the high group already had good skill in creating coherence at the beginning of the semester. It was the middle group, and particularly those who had studied the material diligently, Rudy and Tomas, who had room to develop and the grasp of material necessary for doing so.

Their were the classic cases of students who seem to write what they have memorized, ignoring almost totally the questions they are to answer or the demands of the assignment. On the first essay, it is
true, everyone except Richard and Carl in the high group ignored the thrust of the lead-in sentence. This sentence was:

Muscle cells are cells specialized for contraction.

Almost everyone wrote about muscle cells—the shape, structure, the number of nuclei, and so on, for the three different kinds of muscle cells with hardly a sentence about contraction. They apparently found themselves locked into a set of information, much of it unrelated to the processes of contraction. They seemed to know this set very well, and to find it easy to lift it straight from their memory of lecture notes, like a large chunk. But the others, by at least the third essay, had responded to the investigator's admonition to be relevant to the lead-in sentence. Rudy and Tomas had not.

The Chunk Hypothesis

The pattern of the written work of both Rudy and Tomas was a pattern that might be described by a "chunk hypothesis," a chunk being perceived by the reader as a passage that has some sort of internal structure but is off the point of the main argument. At the beginning the work of Rudy and Tomas was largely chunks, but these either disappeared or became shorter in later essays. By the final pieces of writing, both students were quite deliberately imposing their own structure rather than using pre-structured information.

What was the nature of these "chunks"? Their structure can, in some cases, be described by the rather odd pattern that showed up in the grid-style analysis. A symptom of the presence of a chunk was the lack of rhetorical labels in the rhetorical links column, but in other ways the chunks had coherence of their own.
An illustration: the pattern of the introductory form. One kind of chunk was a descriptive form called here the "introductory" form, which had a characteristic grammatical pattern. Typically when Rudy and Tomas used it, they nominated a topic for the paragraph, then used this topic as the sentence topic for almost every sentence. Coherence depended on the repetition of the topic. The predicates of each sentence offered new information about the topic, each one adding something more until there was quite an accumulation of descriptive detail. The form was something like the following set of sentences for which "Mary" is the topic:

Meet my sister Mary.
She lives in Newton, Mass.
She has three children, Algernon, Toby, and Elizabeth.
Her husband is in insurance, and she goes to night school three nights a week.

A characteristic of this style is that sentences can change their place in the paragraph with little damage to the coherence of the whole. Some sort of overall impression no doubt emerges after several sentences, something that connects the various predicates, but the effect is cumulative rather than a step-by-step unfolding or progression. Instead of connectedness between predicates, there is connectedness between sentence topics.

As each sentence above said something about Mary, so each of the student sentences for the first essay said something about muscles. Repetition was the cohesive device, repetition of the paragraph topic. A typical Essay 1 showed a pattern of sentence topics like the following:
In almost all of the sentences, except the first one in a paragraph, the topics were the same, and there were few if any reference links from topics back to earlier predicates. This explains why readers felt that the main predicate of the first sentence, "specialized for contraction," was ignored.

Neither did the topics refer to any knowledge assumed on the part of the reader. If, suppose, the sentence topic had been:

The outer covering of the muscle

or

The contraction of the muscle

then part of the topic would have been the understood sentences:
The muscle has an outer covering.
The muscle contracts.

Part of what the writer would have been referring to would have been this assumed information. In the analysis by columns this would have shown up as a connection made through deep-structure sentences rather than by means of repetition, in surface sentences. But there were no connectives of this kind.

Among the sentence topics there was also a notable absence of nominalizations such as "the sliding action of the fibrils," or characterizing references such as the word "process," which might have been used to refer back to a whole set of events. All this is to suggest that the sentence topics served a limited purpose. All they did was to keep the reader's attention focused on the paragraph topic. Whereas they might have been used to refer to pieces of earlier predicates, to relationships earlier established, or to knowledge assumed on the part of the reader, they were not used in these ways. The topics did nothing to link with the topic/comment connections already made. They linked only with earlier topics.

What held the sentences together, in addition to topic repetition, was a parallelism in verb type. That is, within a single paragraph, the verb type was apt to be the same from one sentence to the next. The type was almost always statal, though there was now and then an exception to this, as in the series:

- Certain muscle cells are **spindle-shaped**.  
- They **have** more than one nucleus.  
- They **form** bundles.  
- They **move** rapidly.
In sum, the sentences of the "introductory form" were held together by repetition of the sentence topic and by the parallel structure of verbs. Such a pattern produced a student passage like the following:

<table>
<thead>
<tr>
<th>topic</th>
<th>verb type</th>
</tr>
</thead>
<tbody>
<tr>
<td>(not clear) The walls of the veins are surrounded by smooth muscles.</td>
<td>statal</td>
</tr>
<tr>
<td>smooth muscles</td>
<td>These type of muscles are innervated by the nervous system or by local or humeral influences.</td>
</tr>
<tr>
<td>smooth muscles</td>
<td>There are two types of smooth muscles present around the veins.</td>
</tr>
<tr>
<td>type of smooth muscle</td>
<td>One is located in the outermost portion and is called the multi-unit smooth muscle.</td>
</tr>
<tr>
<td>smooth muscle</td>
<td>The inner layer of smooth muscles is called the visceral smooth muscle.</td>
</tr>
<tr>
<td>smooth muscle</td>
<td>The multi-unit smooth muscles are innervated by the nerves coming from the central nervous system.</td>
</tr>
<tr>
<td>smooth muscle</td>
<td>The visceral smooth muscles are innervated by hormones or drugs which have similar effects to epinephrine or acetylcholine.</td>
</tr>
</tbody>
</table>

(student: Tomas, Essay 4)

Where had the chunks come from, or in other words, what was the source of the information used by Rudy and Tomas? Clearly they used what they had learned in lecture, not only the information but the whole organizing principle as well. This investigator had sat in on the lectures and could compare the organizational scheme of the lectures with the structure of the chunks. They were much the same.
The introductory form in science textbooks. The structure of the chunks not only resembled the organization of the lecture. It was also like that of several textbooks examined in the course of the investigation. This finding is no surprise, since writers no doubt pick up a sense of the structure of written discourse from what they read. It was interesting that the organizing principle they imitated was the one used by professional science writers introducing a new discourse topic, or opening a chapter, or new section of material. As in the student writing, the devices for maintaining coherence used by these professional writers were mainly topic repetition and the parallel structure of verb type. Again, there was not the kind of semantic or logical connection between sentences that one expects in, say, argumentative prose.

This introductory pattern was apparent in the introductory passages of three different science textbooks. The age level or sophistication of the audience made only a little difference in the structuring device used by the authors. The younger the intended audience, the closer was the structure to the one described here. The older or more sophisticated, the more variation in the pattern.

For a sixth-grade text, the pattern was like that used by Rudy and Tomas in their introductory chunk-style material:
The heart in man and the other mammals is a muscular organ in the chest region. Its primary function is to pump the blood in the blood vessels through the body. The heart is made up of cardiac muscle which is held together by tough, connective tissue. About the heart is a tough, protective sac called the pericardium (per'ka-r'diam). Within the pericardium and about the heart is a fluid which reduces the friction between the beating heart and the other tissues. The heart is a hollow, muscular organ, somewhat like a cone. The heart is divided into four chambers—the left and right atria (atria) and the left and right ventricles (ven'trik'lz).

In more advanced texts, the same pattern is apparent, though with more variation. It is used by the authors of a well-written science text that has become part of the Nuffield curriculum project materials for advanced high school ages. The passage reads in the following way, paraphrased here for convenience. (The exact version comprises Appendix A, p. 160.)

There are three types of muscles. Cardiac muscle is immune from fatigue. Smooth muscle has discrete cells, each with a nucleus. Smooth muscle is slow to act. It is found in the gut and bladder. Its rhythm is controlled by the nervous system. It can exert a large force for a long time. These cells can lock themselves in a contracted state.
Except for the first two sentences, the topics are "smooth muscle" or "smooth muscle cells." Except for some connection between "slow to act" and "long time," there is little connectedness between the various predicates. (A few example sentences have been omitted that were related to the general statements they followed.) The most telling evidence is that several sentences could change their positions in the paragraph without damage to the structure of the paragraph.

The introductory form used by the students, then, has two kinds of qualities. First, it is remarkably like that of the introductory paragraphs of the examined textbooks, and second, its requirements for coherence are grammatical rather than rhetorical. When it came to listing rhetorical connections such as cause, comparison, or illustration, this investigator could find very few. Both of these qualities may explain why students chose the form. They imitated what they saw and heard, but they imitated those forms that did not require rhetorical or logical relatedness between statements but required only a kind of topic relatedness.

Such a form was appropriate for the opening pages of the chapter of a textbook, when very little knowledge is assumed on the part of the reader, but not appropriate for a student essay that presupposed a good deal of knowledge on the part of the reader. The lead-in sentence signalled what information should be taken for granted, or presupposed. What the students did in using the introductory form was to assert what was presupposed. To do so is clearly a violation of a basic communication code.
Chunks in the Work of Rudy Over the Semester

Most of the remainder of the chapter will examine the semester's work of Rudy, one of the two students for whom there was a genuine struggle between material and message. (Appendix B includes Rudy's Essays 1, 2, 3, 4, 5, 6, 8, and 10, or at least as much of each essay as could be typed on a single page. Essay 12 is typed in total.)

Both Rudy and Tomas seemed to have made a good deal of investment in their material. It had taken a long time to memorize it, and to have done so marked the difference between failure and a measure of success. For Tomas, the ability to study and memorize had no doubt been the reason for his earning a scholarship to the University of Washington after a year at the University of Guam. As for Rudy, he had got where he was by buckling down in college. In high school he did no studying to speak of, he told this investigator, and now he knew what it was to study. Both were reluctant to give up or change the structure of the material in their possession. Rudy--because he was the more reluctant of the two to change and because his writing is such a clear example of what seems to be a common difficulty for "successful" minority students--is the focus of much of this chapter.

A trade-off between relevance and style. When Rudy used chunks, his writing was readable. When he did not, his writing was incoherent in the usual sense of the word, quite without logic or flow. His writing fit one of these two descriptions for the first nine essays he wrote. The first two essays, though they went off in the wrong direction, were readable. In view of this fact, one was astonished at Essays 3 and 4, which were bewildering to read and full of bumps and
jolts. By contrast with 3 and 4, Essays 1 and 2 were easy to follow, so long as one could ignore the first sentence.

In fact, the prose of Essay 2 was so smoothly put together that it encouraged the investigator to do just this--ignore the first sentence. The structure was something of a listing technique but more complex in structure than the introductory format. The topic that Rudy wrote about was one commonly covered in textbooks--the methods used by the body for generating ATP, the energy needed by the muscles for contraction. Rudy established that there were several ways of generating ATP, or the energy for muscle contraction. He proceeded to name them: "glycolysis," "oxidative phosphorylation," and so on, and also to show at what points each method came into use. The grammar was correct, the prose though complex was easy to follow, and everything was related to the general notion of methods for generating ATP. Rudy received one of the highest marks he was to receive all semester, a B+ grade. There was just one oversight on the part of the investigator: the lead-in sentence asked not how ATP was generated but how it was used by the body after it was generated. The whole essay was off the point and should have received a low mark. A passage from this essay is included in this chapter for purposes of illustrating the smoothness of what was really a chunk of material irrelevant to the lead-in sentence.

By contrast, Essays 3 and 4, which were incoherent hodge-podges and which received low grades, were more relevant to the lead-in sentence. The chunks were broken up by sentences intended by Rudy to be links to the lead-in sentence. But the bridge-like sentences had the effect of breaking up the flow of information. They impressed the reader as interruptions.
In Essay 3, an excerpt of which is typed on p. 63 after an Essay 2 excerpt, the lead-in sentence says that differences in the structure of cardiac and skeletal muscle are suited to their differences of function. Rudy, in his sentences that follow, attempted to show that the different membrane properties of the two kinds of muscle cells allowed for ions such as sodium and potassium to move in and out of the cell in greater or smaller quantities. This difference, in turn, was responsible for different rates of contraction for the two kinds of cells.

But the words "different," "greater," and "smaller" introduced a comparative notion into what were, for Rudy, two separate lines of thought, one line about skeletal muscles and one about cardiac muscles. He had extreme difficulty keeping his information about these muscles subordinate to the comparative purpose. The result—and what accounts for the hodge-podge effect—is a series of unconnected sentences, some with comparative force and some without. Sentences 6, 8, and 9 (Essay 3, p. 63) have no connection to the comparative ideas in sentences 3, 4, and 7. The comparative sentences say that one kind of muscle cell is slower to contract than the other. The non-comparative sentences say that the important ions are calcium, sodium, and potassium. Sentences 8 and 9 give more detail about ions, specifying where they are found and what the purpose of calcium is. All of this is puzzling, to say the least, because the link between contraction and ions has not been made. Admittedly the link is made in sentences 2 and 5, but the other sentences must also refer to the relationship or be seen as irrelevant to the paragraph. The general reader would have no choice
Essay 2 (excerpt)*

1) There are several ways of generating ATP or producing ATP for muscle contraction. 2) Normally the production of ATP is found to occur within the cytoplasm of a cell and also within the mitochondria of the cell. 3) If ATP is produced within the sarcoplasm of a muscle cell, it is normally ATP production from glycolysis. 4) If ATP is produced within the muscle cell mitochondrion, it is called oxidative phosphorylation. 5) Besides glycolysis and oxidative phosphorylation, ATP can also be produced from phosphagen pools, such as creatine phosphate and originine phosphate.

Essay 3 (excerpt)

1) Certain characteristics contribute to important functional differences between cardiac and skeletal muscle. 2) [sentence fault] are primarily related to the movement of certain intracellular and extracellular inorganic ions. 3) The primary functional difference between skeletal muscle and cardiac muscle is due to the rate of contractions. 4) The rate of contraction of skeletal muscle is much slower than the rate of contraction in cardiac muscle. 5) The rate of contraction in muscle cells are directly influenced by the permeability of the muscle cell membrane to certain ions. 6) The change of the muscle cell membrane permeability, as a result of nerve stimulation, can cause an action potential to be generated throughout the cell membrane. 7) The magnitude of the action potential is somewhat directly proportional to the rate of contraction. 8) The principal inorganic ions which plays an important role in muscle contraction are calcium, sodium, and potassium. 9) Potassium is the principal intracellular ion, sodium is the principal extracellular ion and calcium is an important ion that promotes muscle contraction.

* All student work is typed as it was written, though sentence numbers are added for convenience.
but to view most of the sentences as irrelevant—unless he is a sympathetic biology professor who, in his own knowledge, fills in the missing relationships. To make matters worse, the grammatical fault at the beginning of Sentence 2 made this sentence unreadable. It was attached as a "run-on" to Sentence 1. The impression for the reader is one of almost total incoherence.

Overall, the contrast between the passages from Essays 2 and 3 could not be more marked. Essay 2 is smoothly structured and easy to read. Essay 3 is nearly impossible to read. But the first is a chunk—put down on paper as it must have been received—and the second is Rudy's own attempt to bring together information that had not been brought together for him in lecture. At this point in Rudy's development there is a trade-off between relevance and readability. When he tries to advance the assertion made in Sentence 1, he produces chaotic prose. He can apparently produce smooth, flowing prose only when he reproduces the material in the form in which he received it.

The trade-off at the sentence level. Sentences in Essay 3 appear to be newly un-chunked or pulled out of whatever structure they were previously part of. These are the sentences mentioned above—6, 8, and 9—the ones with no comparative force. Notice that they are concise, smooth, and graceful, like short versions of longer chunks:

6. The change of the muscle cell permeability, as a result of nerve stimulation, can cause an action potential to be generated throughout the cell membrane.

8. The principal inorganic ions which play an important role in muscle contraction are calcium, sodium, and potassium.
9. Potassium is the principal intracellular ion, sodium is the principal extracellular ion, and calcium is an important ion that promotes muscle contraction.

These small chunks, just like the large ones, were irrelevant to the author's purpose, even if they were smoothly written. The "new" sentences, on the other hand, created by Rudy to meet the demand for comparison, were relevant but poorly written or wordy:

3. The primary functional difference between skeletal muscle and cardiac muscle is due to the rate of contractions.

4. The rate of contraction of skeletal muscle is much slower than the rate of contraction in cardiac muscle.

7. The magnitude of the action potential is somewhat directly proportional to the rate of contraction.

In a sense, therefore, a hodge-podge essay was a sign of development, for ordinarily this meant that Rudy's long chunks were being broken up. The sentences most disruptive in the line of thought were attempts to re-establish a link with the lead-in sentence. Though he could not quite manage it, Rudy attempted to carry on with what he must have seen as two separate topics, one the topic of comparison and the other the topic of muscles, the topic of muscles having sub-parts skeletal and cardiac. While he failed to integrate the two topics successfully, he at least brought them together by juxtaposition. He juxtaposed a content sentence (like 6) with a comparative sentence (like 7).

The dull, clumsy sentences such as 3, 4, and 7 above were an indication that some sort of relating work was in progress, in this case comparison. Some sentences of this type, in fact, could be called
"working sentences," for it is clear that in writing them, Rudy had to fumble and search for a means of expressing the comparative relationship. He no longer had the fluency and confidence he had when writing chunk-style information.

Such "working" sentences occur in his Essay 6, of which the general topic was the importance of large surface area for the digestive and respiratory systems. He wanted to say that small structures exist within both the lungs and the small intestine that poke out from the surface, creating a great deal of surface area. Over this surface area gases are exchanged in the lungs or nutrients are absorbed in the intestine. The structures in the lungs are called alveoli and the ones in the intestine villi and microvilli.

In writing this, Rudy got as far as saying there existed alveolar ducts in the lungs. At this point he wanted to say that the more alveolar ducts there are, the more alveoli there will be, and the more alveoli there are, the more surface area, and the more surface area, the greater the opportunity for efficient gas exchange. In the process of trying to say this, his sentences became labored, full of cross-outs and insertions. Consider what he must have been trying to do as he wrote and crossed out the following:

Therefore, the more alveolar ducts there in the lungs will have more alveolus and hence, a greater exchange of carbon dioxide and oxygen surface area for gas exchange to take place efficiently.

He labored over the connection between the greater number of alveolar ducts and the greater number of alveoli. Still it did not come out quite right:
the more alveolar ducts in the lungs will have more alveolus

Crossing out the "there" in the first line released him from one kind of sentence structure, which would have been:

the more (something) there are, the more (something) there will be

At the same time the change of structure caused by the deletion of "there" led to a fault in the second part of the sentence. Now it read:

The . . . ducts . . . will have more alveolus and hence a greater surface area . . .

To say the ducts will have greater surface area was inaccurate. It is not the ducts but the lungs that will have the greater surface area.

The relation of chunking to Rudy's perceptions and purposes. Essay 6 was a high water mark for this time of the semester. Not until Essays 10 through 13 did Rudy again show the same willingness to focus directly on the argument laid down in the lead-in sentence. Most of the other essays were off focus, either completely (as in the irrelevant Essay 2), or somewhat (as in Essay 5), or just slightly (as in 7 through 9). In all of these essays he used small chunks of information that seemed to be pulled from an "introductory format." When a noun was introduced, it was frequently accompanied by a good bit of irrelevant information--names of things and random properties or attributes. Perhaps the confusion he encountered writing Essay 3 and the syntactic difficulties in which he found himself in Essay 6 persuaded him that it was best to stick to information he felt comfortable with and not to attempt breaking the information down, extracting the relevant bits, and then re-combining.
More likely, however, the changes in Rudy's willingness to attempt this kind of shuffling of information should be viewed as a function of the assignment rather than changes in his attitudes or perceptions. Some of the lead-in sentences (and these included the ones for 3, 6, and 10 through 13) left Rudy no choice but to build a structure of information that suited the assignment. This was because the lead-in sentences linked two body systems, such as the respiratory and digestive systems, which had not been linked in class lectures. There was thus no large body of notes about the connections between these two systems and consequently Rudy could not "borrow" the structure of this information. All of the other lead-in sentences (the ones for Essays 1, 2, 4, 5, 7, 8, and 9) concerned themselves with a single body system. Since lectures were organized around body systems, there were whole blocks of information on the subject, or chunks, which Rudy felt free to use without modifying the sequence of information.

Essays 5, 7, 8, and 9 were all in this category. They all included relevant sentences but also irrelevant ones. The essays as a whole, aside from the first sentence, read like an interconnected piece of writing. They began at a particular point, proceeded through an orderly sequence, and then ended—all very nicely arranged and readable. But the burden was on the reader to find the relevant material. Rudy had not taken on the responsibility of structuring the information so as to make its relevance clear.

Take, for example, Rudy's Essay 5, for which the lead-in sentence was:

The digestive system has immune system components.
The intended topic is the immune system components that are located in the digestive tract, these being in some cases structures like lymph nodes, in other cases structural features like tight-fitting "junctions" between cells to keep out invading bacteria, and in still other cases processes like mucus secretion or phagocytosis, a kind of swallowing-up of the invading bacteria. To arrange this information was a complex task. Most students did it by categorizing the data in one way or another—as specific and non-specific responses, or as physical and chemical barriers. Some classified the immune components by their location along the digestive tract—higher, middle, and lower.

But what Rudy did was an extreme of this last method, the "geographical" one. He had apparently learned his information in this arrangement and could not change the structure of what he had learned. He began his essay by naming the four layers of the wall of the alimentary canal, or the digestive tract—again the introductory format. Having done so, he then mentioned immune components. And why? Because he had arrived at their location. The components were located in the top two layers of the digestive tract. He did the same for the sub-layers of the topmost layer. He used four sentences to name these layers, and having arrived at the appropriate sub-layer (the "lamina propria"), he mentioned the immune components based in this layer. It was not that he felt immune components were unimportant, only that they should wait until he had made his way to their site. His method not only obscures the relevant detail about the immune components, but it also encourages him to introduce irrelevancies such as "loose connective tissue," which has nothing to do with either digestion or immune functions but happens to be found at this site.
Not until the end of this paragraph does the reader find the material he expects:

The lymph nodes in the lamina propria produce the major immunological cells, the T-lymphocytes, B-lymphocytes, and plasma cells. These cells participate in the specific immune defenses of the body. White blood cells found here are the monocytes, eosinophils, and basophils. These cells participate in the non-specific immune defenses of the body.

The relevant material is well written, but its placement at the bottom of the paragraph nearly obscures it. Of the first 14 sentences, only six relate to the immune system. The other eight are taken up with the naming of layers. In the paragraphs following this, the proportions are changed, giving more space to immune components and less to digestive layers. But even here the inappropriate structure of his information is apparent, as revealed by the connective devices used in the opening sentences of his paragraphs.

A typical paragraph opening is this one:

The submucosa is the next layer adjacent to the mucosa layer. This layer consists of dense connective tissue and also an accumulation of lymphoid tissue. These lymphoid tissues are responsible for processing specific immunological cells . . . etc.

To the reader, who expects the immune components to be primary and the location in the mucosa to be secondary, such a paragraph opening is strange. But to Rudy it was apparently not strange. The lead-in sentence had begun with the digestive system ("The digestive system has immune system components"), so why shouldn't he?

In a taped interview with Rudy he implied at first that his problems with relevance were caused by the length requirement for the
writing exercise. To be direct or "to go right to the point of the lead-in sentence" would cut down on the amount of material he could use. There was quite a discussion about "direct" writing:

Rudy: If I write something direct, I [unclear] not fill up the two pages.

Investigator: Is that what's bothering you?

Rudy: Yeah, that's what's bothering me.

Investigator: Ah-h-h-h.

Rudy: See, like I think--I dunno--you're expecting us to fill the two pages, right?

Investigator: Yes, but you know what--you write about twice as much as anybody else.

Rudy: Yeah, but if you talk specifically, directly, it's going to be only one page.

Investigator: Do you think you could take a risk and try it?

Rudy: Well, for instance, I could talk about smooth muscle, its involvement in cardiac output. I could summarize it in this much, I think. [Gestures to indicate a small space.]

For Rudy an important cognitive problem, and a problem shared by many students, was in not knowing how the information within his control bore on the general statement in the lead-in sentence. In the case of smooth muscle and cardiac output, it was a problem of figuring out which information was needed for elaborating on the following sentence:

Smooth muscle action affects cardiac output.

The sentence says that the muscles lying in the main blood vessels have some effect on the amount of blood put out by the heart with each beat. To the students in the high group of the class the relevant material was a chain-like series of events that began with the squeezing action
of the muscle and ended up with greater cardiac output. The steps in the process were several and complex.

But Rudy's next remarks in the interview reveal the way in which he selected material for its relevance to the statement.

Investigator: OK. Let's try it [the direct way]. Just for a little exercise here, suppose you went directly to it [pointing to the sentence "Smooth muscle action affects cardiac output"]. What would you say?

Rudy (reading): "Smooth muscle action affects cardiac output." OK. First, I would write about the location of smooth muscle in blood vessels. OK. and how they are arranged.

Investigator: OK. To me that's not direct.

Rudy: It's not direct? OK. To me, it's direct. The way they are arranged is the way they contract. They have certain ways of contracting. Arteries, OK, they are arranged circally. OK. and as the smaller the vessel gets, there is more smooth muscle there.

To Rudy, the "direct" way to talk about the effect of smooth muscle action on cardiac output was to describe smooth muscle, to say where it is located, and how it is arranged. Sooner or later he would get around to the part about cardiac output. To Rudy there was no problem. He would come to all of this—what the smooth muscle did and how it made the output of the heart smaller or greater—if the reader would wait. He had come to the connection between muscle structure and muscle function (Essay 1) after the first 25 sentences. He had come back to the point of the lead-in sentence in Essay 2 in the last sentence, Sentence 35. One senses by his remarks that the proper place to come to the point of the central relationship is in the conclusion. The bulk of the essay should consist of material that naturally comes
first. What comes first is location, arrangement, definition, the naming of component parts, and appearance. His next taped comments were on the topic of cardiac muscle. (The marks of emphasis are his. The periods mark pauses, not the deletion of material.)

Rudy: We was talking about cardiac muscle. OK. What I do--like--I would explain what is cardiac muscle, physical characteristics of it, then I would explain the chemical characteristics, then I would conclude.

Investigator: How would you conclude?

Rudy: Uh--to summarize the physical and chemical characteristics, that's all . . . what I see as important.

Investigator: What do you see as "characteristics"?

Rudy: Physical characteristics is like location . . . and what a thing looks like . . . and comparing that with other muscles and based on that . . . physical appearance . . . what certain features that they can do.

The investigator's remarks about "directness" had missed their target. Rudy agreed that writing should be "direct," but whereas the investigator had meant that it should bear directly on the assertion of the first sentence, Rudy had in mind that one should go directly through the "appropriate" sequence of information. First in Rudy's scheme of things were statements about the structure of the body. Statements about the way the body works come along later, these being the "features that they can do."

It became clear in reading his Essay 7 that when the appropriate sequence was a time sequence, it was necessary to start at what he considered the "right moment" in time. When the lead-in was this:

A hormone may have more than one target cell and thus regulate more than one activity.
Rudy quite correctly thought of the chronological sequence of hormones traveling to target cells and then causing those cells to act in certain ways. But for him the right moment in this sequence was not the moment of hormone secretion. For him the narrative properly began with the existence of glands because it is glands that secrete hormones. Even though glands were not relevant to the writing task, their existence was seen as prior to that of hormones. Therefore, all Rudy's examples of hormones begin with the naming of glands. Glands belonged at the beginning and could not be lopped off. There are therefore "extra" sentences at the beginning of each example narrative that the patient reader will have to find his way through in order to arrive at the relevant material. For instance, in the following passage the relevant information makes its appearance only in sentence 6 and after.

1) A hormone may have more than one target cell and thus regulate more than one kind of activity. 2) Specific body organs that secrete these hormones which act upon more than one target cell are the adrenal medulla, thyroid gland, parathyroid gland, and pituitary gland. 3) The adrenal medulla is a neuroendocrine transducer gland. 4) After receiving a sympathetic postganglionic stimulus, the adrenal medulla secretes the neurotransmitter norepinephrine. 5) Norepinephrine is then dumped into the blood and is carried to the specific cells that it will react with or affect. 6) Norepinephrine can act upon numerous cells of the body. 7) Norepinephrine can regulate heart rate, oxygen consumption and insulin production. 8) The adrenal medulla also can secrete another hormone called epinephrine. . . . etc.

Teacher Intervention, Rudy's Case. Rudy's reluctance to change was to this investigator a disappointment and a challenge. Surely it was possible to show a student that information, while it could be usefully stored away in a tight structure, had to be extracted from
that structure to suit the demands of the discourse. Once more the investigator tried, what was to her, a direct approach. This time all the relevant sentences of Essay 8 were circled, then copied out on a separate sheet of paper to show that these sentences on their own would make a connected essay. A comment was written at the bottom of his essay, asking Rudy to read the revised version and to compare it with his returned copy on which all the relevant sentences had been underlined. All sentences not underlined, said the comment, counted against his grade, even though they were true.

The last bit of this comment must have rankled, for when Rudy came to the next writing exercise, he looked wounded and a little hostile. "Why I get so low grade?" he asked. "I write all true things. My grammar? Is it bad? What you grading on?"

The investigator's response was a general one: Relevance was important and some material, even though it was true, was not relevant. In a piece of writing, irrelevant material was confusing.

In the middle of the writing exercise, he came to the desk for more paper. "Maybe," he said, "yeah . . . maybe I catch."

On the essay he wrote that day, however, his method was the same as before. Doing a rewrite of the essay on hormones and target cells, he began again with the glands, and again presumably because the information properly began with the glands. Rudy's information, as always, seemed bound to the structure in which he had received it.

But when it came to the last four essays, Rudy showed that he had figured out how to select the relevant material. (See his full Essay 12, Appendix B, p. 169.) At this point in the semester and on an
assignment which gave him no choice but to build a structure of his own, he was able to do it competently. There was marked progress over his early essays, although no definite assurance that he would not be distracted in the future by those structures of information with which he was already familiar.

Rudy's apparent conception that information was bound up in some sort of appropriate structure was a conception shared to some degree by several others in the group. If not a conception, then certainly it was a habit of mind that had developed from a learning strategy. Tomas too had the tendency to pick out a noun phrase from the first sentence and then to provide information about this single noun phrase. Typically, he either named it, defined it, located it, or named its component parts. This tendency explains the occurrence in the writing of both students of sentences like: "This type of contraction is called the isovolumic contraction" or "This is a simple columnar epithelium" or "This cycle has four stages." Such sentences either occurred alone, in which case they were momentary distractions, having no apparent relation to the argument at hand, or they were part of a set of such sentences, none of them related to the argument of the lead-in sentence. But in either case they were there, not because the student made a mistake but because the student thought it right and proper, having introduced a noun phrase, to produce its adjunct information. For a teacher to advise subordinating--or sentence combining--would arguably have little effect in the long run. As shown by later essays, both Rudy and Tomas knew quite well how to subordinate information of this type. In their early essays they did not subordinate such
information because they did not believe it was subordinate. Names, definitions, locations, and component parts were important enough in themselves to merit the status of a main clause.

Other Students and Chunking

Other students too were inclined to view certain information as fixed, inflexibly bound into a particular arrangement with other information. When the subject was the circulatory system, then the information should have begun, in their view, with the heart. Thus, when the lead-in sentence was:

Smooth muscle action affects cardiac output.

there were two or three students who shook their heads and wrinkled their brows.

"Smooth muscle?" One student stared at the paper for at least five minutes, finally looked up, laughed a little, and said with some exasperation, "You can't start there."

For this student and others, the action of the smooth muscle was somewhere in the middle of the process, since smooth muscle was located not in the heart but in the blood vessels. The story properly began with the cardiac muscle, located in the heart. The role of smooth muscle did not rightly enter in until later in the story when the blood had traveled out of the heart, through the arteries, and into the smaller arterioles, where such muscle was located. So binding was the story of circulation, as it is usually told, that students could not see the events of circulation structured in any other way.

The eleven people in the study could be categorized according to the extent to which they were bound rather rigidly by information
structure. Rudy and Tomas were certainly the most. The other nine students were much less so, but of these nine, only the ones in the high group were free of structure in a positive sense. For the ones in the low group, and to some extent the others besides Rudy and Tomas in the middle group, the freedom from structure was not an advantage. They seemed unable to remember facts and information, and would have done well to emulate Rudy and Tomas. They apparently did not (with the exception of Marilyn late in the semester) make the prodigious effort made by Rudy and Tomas to memorize information in the order of the course outline. Perhaps they had less general science background when they began, perhaps their study habits were poor, and perhaps for the four non-native speakers they had trouble with quick comprehension of the language. Of the non-native speakers, only Tomas was able to gain sufficient mastery over the material, in this his second try at the program.

For those in the low group the first step toward better learning might be the memorizing approach. For them to view circulation as having a fixed starting point was perhaps a good beginning. The consequence of such a learning strategy might well be writing that followed slavishly the structure of the memorized information, but this may be a necessary consequence.

It was surely a cognitive effort of some proportion both to store the required quantities of information, in whatever fashion this might be, and also--on command--to shuffle the information so as to create a structure appropriate to the writing task. There were two students in the high group, Carol and Richard, who structured and re-structured as
though it were second nature to them, and there was one more student nearly as good. Not only were their essays impeccably organized and almost free of irrelevancies, but they were also shorter than those of Rudy and Tomas. They wrote less and spent more time looking in the air than did Rudy and Tomas; the signs of conscious manipulation and structuring were there. In conversation also there were signs that they processed information, and did not just deliver it.

Richard, in the course of his interview, showed that he organized the course material hierarchically. Starting with the body as a whole, he thought next of the systems that make up the body, the organs that make up the systems, the various components that make up the organs, and the cells that make up the components, and finally the parts of the cell. But, he said, you can also think of the information as beginning with the chemistry of the cell. What happens there affects what happens to each bigger component on up the line. So you can go down the hierarchy or up, it makes no difference. Or, he said, you can think of the structure of the body vs. the function of the body. Or, he said, you can sometimes think of it all as a battle between disease and health. The body does such and such if such and such happens. Certain events occur under pathological conditions, and others occur under healthy conditions. This student, needless to say, took time to stand back and look at the forest. He knew more than the names of the trees.

The other student whose structuring abilities were impressive was Carol. She quite consciously organized her material in terms of generalizations and examples, differences and similarities, causes
and effects. She talked in this vein during her interview and she wrote at the end of the course on her evaluation that she would study for the final in the way that she thought about her essays—looking for relationships between the items of information.

The fact that the later essays of Rudy and Tomas were relevant and coherent—each paragraph, for instance, related to the lead-in sentence by a referring sentence of some sort—shows that with practice they were able to work with their own organizing principles rather than using borrowed ones. Presumably they too will be able, both in speech and writing, to reshuffle information to fit a particular discourse demand.

Will they ever be like Richard and Carol? Perhaps not completely, for habits, by definition, are hard to break. Yet there is in their writing some evidence for the belief that what they showed in their early essays—the chunk-style—is a developmental stage. For them, perhaps it was useful for their final success, both in learning and in writing, to begin with information in some pre-structured form. The process of breaking and re-combining for purposes of arguing for a certain point may be so demanding in itself that students cannot handle it at the same time that they are in the process of retrieving information. Clearly there is something very difficult about the process of re-combining material. It is this point on which the following chapters will focus.

It is worth more than a footnote to say that Rudy and Tomas were among the six of the eleven who were admitted to medical school. The other four were Richard, Carol, and Carl in the high group as well as
Marilyn in the middle group. Marilyn made a prodigious effort in the last few weeks, overcame the personal problems that had bothered her, and managed to learn a mountain of information before the final examination. None of the students in the low group was admitted, but the experience of Tomas is instructive, for in his second try at the program, he was successful. It is fair to infer that in the first year, he was overwhelmed by the information and only in the second could he begin to make sense of it.
NOTES


Predication Load

This chapter will argue that the difficulty level of the pre-medical writing task was related to information type. It assumes that the assignment dictated, in ways that were both explicit and implicit, the types of information that had to be used. Not to carry the "right" kind of information, and the right combination of information, was to be off the point or irrelevant.

It argues that to maintain coherence the student writers had to continue carrying not just a single type but more than one. Like generals in command of several armies, they had to keep in mind the movement of each type and advance each one as the need arose. It was the repetition of the same information type from one sentence to a later sentence that constituted coherence.

Therefore, to be both relevant and coherent, the writer had to carry the number of information types required by the assignment and to continue to carry them, once he had introduced them, for some undetermined length. It was especially important to carry the content types required by the assignment in combination with the relational type. What this meant for the individual surface sentence was that it had to be a combination of types, or to have--in most cases--more than one type of deep-structure sentence underlying the surface.

Each underlying sentence communicating a type of information is termed a predication. The number of predications and the number of types of predication within a sentence were a useful way of measuring
the cognitive dimension of the writing task. These numbers constituted the load which the writer had somehow to handle. The two measures are both parts of what will be called the load of predications.

Information Types

There were, for every biology writing exercise, three types of information required. There was, first, information usually about the structure of the body, such as where elements were "found," or "located," what they were "composed of," what they "comprised," what they "formed," what they "had," how they were "arranged," what color or shape they "were," what the body "needed" or "required." Such information is characterized by the syntactic properties of the statal verbs in quotation marks above and also by the characteristic sentence topic, "the body." It will be called body structure information.

Second, there was information about what the body did, whether it--or parts of it--"contracted," "squeezed," "inhaled," "flowed," "diffused," and so on. The topic is "the body," and the verbs are dynamic. It will be called body function information.

Information of the third type, relational information, showed how various elements are related to each other by comparison, cause, time, and so on.

Whereas information of the first type was:

Skeletal muscle cells are spindle-shaped.

and information of the second type was:

Skeletal muscles contract rapidly.
the third type showed relationships, sometimes between sentences of Type 1 and Type 2:

The spindle shape of the skeletal muscle cell allows for rapid contraction of the muscle.

The phrase "allows for" has within it the relational idea of CAUSE, for in some way the spindle shape of the cell causes the muscle to contract rapidly. Neither the logician nor the biologist would go along with this definition of "cause," for the spindle shape does not really do anything--it just is--and so one finds it hard to imagine the shape causing something. And besides, it is not a complete cause, just part of the cause. But to call it CAUSE helps to simplify the grammatical explanation, for it can be the general term for the category including purposes, reasons, goals, results, effects, and conditions, all of them relationship words that imply a connection between earlier events and later events that is more than accidental. Some words, like "prevent" or "inhibit" or "generate" have within them the notion of CAUSE but mean something else as well. "Prevent," for example, means "do-something-to-CAUSE-not-to-happen."

The notion of purpose, part of CAUSE in this analysis, can be conveyed in a number of ways, as with the phrase "in order to" in the following ungrammatical sentence written by Jesus:

They are supplementary with each other in order to keep life continues.

or very directly, as in this sentence also written by Jesus:

The primary function of the immune system is to protect the body from infections.
Similarly, notions of comparison (either likeness or difference) were expressed by Jesus in a variety of ways. The following way makes the relational predication the predication of the surface sentence:

The two systems of the body have different purposes and functions.

In the following sentences the comparative notion is less direct, as in this one, which contrasts with the sentence above:

But one way or the other they are supplementary with each other . . .

The word "but" signals the intended contrastive relationship, (called here COMPARE): "They are different but they are supplementary . . ." Comparative relationships were also shown by means of single-word adjectives:

There are four proteins in the muscle cell.
The major one of the four . . .

where the words "the major one" say, in effect, that one of the proteins is major and the rest are minor. The present analysis, making use of a deep-structure framework, will show this sentence as having the underlying sentence:

one protein COMPARE ("is different from") other proteins

In the sequence below written by Jesus, two relationships are expressed. One is the comparative idea in the second sentence ("Some are good and some are bad."):

Not all the foods that are taken into the body are good. These foods contain good materials which be absorbed and some are infectious to the body which we will refer them as antigens.

The other relationship in the sequence just above is the specifying one expressed by the second sentence vis-a-vis the first. ("Not
all foods are good. Some are infectious." Such relationships will be labeled SPECIFY. The lead-in sentence:

The digestive system has immune system components.

was SPECIFIED by Jesus in the following way:

Some of the immune system barriers which work in connection with or parts of the digestive system are the glands, mucus, and sometime the spleen.

and also in this way:

The mucus contains antibodies which fight antigens and help to lubricate the foods.

These last two surface sentences are shown in the analysis as having a component deep-structure sentence which makes explicit the relationship:

(something) SPECIFY (something else)

Ready-Made vs. Integrated Phrases. There is an important qualification to make at this point concerning the analysis of sentences like:

The major protein is actin.

It was said earlier that the words "the major" in the surface sentence are the remnants of a deep-structure sentence:

one protein COMPARE ["is different from"] other proteins

There were good reasons to argue for the existence of the deep-structure relational sentence, for it was clear that the writer was differentiating between the one protein that was major and those that were not. But in much writing, there is no such sense of differentiating. There is no such sense, for instance, in the sentence cited earlier from the writing of Jesus: (See also Passage 2, sentence 4, p. 95.)
The primary function of the immune system is to protect the body...

What other functions does the immune system have? Even if there are such, it is clear from the context that the writer is not using the word "primary" to say that one function is primary and the others are less than primary. There is no comparative force in the sentence. Thus, for the analysis, there is no corresponding deep-structure relational sentence.

So it is for other cases as well. If no relational meaning is conveyed, there is no corresponding deep-structure sentence. Isolated surface sentences may be deceiving. It is only in the context of other sentences that one will know whether or not relationships are being expressed.

The example sentences below show that this problem exists not just for relational information but for the other types of information as well. The sentence:

The inhaling of air causes the lungs to expand.

most certainly has the component sentences:

a. (______) CAUSE Sentence b (below)

b. The lungs expand

But is the something that goes in the blank of (a) above the phrase "the inhaling of air," or should "the inhaling of air" be shown as the deep-structure sentence "the body inhales air"? It depends on the context.

Suppose the context is this:
1. Respiration begins with the body's need for air.
2. The inhaling of air causes the lungs to expand.

Then "the inhaling of air" that causes the lungs to expand is derived from the deep-structure sentence "the body inhales air" because the phrase "the inhaling of air" is not a ready-made phrase in the context. The student had to work it out. The analysis of Sentence (2) above would show four deep-structure sentences or predications, as shown below. Each one is labeled by type: Type 1 for body structure, Type 2 for body function, and Type 3 for relational.

2. a. Type 3: Sentence 2 TIME Sentence 1
   (This sentence is in a time sequence with Sentence 1.)
   b. Type 2: The body inhales air.
   c. Type 2: The lungs expand.
   d. Type 3: Sentence 2b CAUSE Sentence 2c.

The same would apply if the first sentence were (instead of "Respiration begins with the body's need for air.")):

Respiration begins when the body inhales air.

because to derive "the inhaling of air" for Sentence (2) requires a nominalization process. The phrase in this case is not ready-made and requires grammatical processing by the student writer.

Suppose the context is this one:

1. Respiration begins with the inhaling of air.
2. The inhaling of air causes the lungs to expand.

Then "the inhaling of air" in Sentence (2) is a reference to a phrase that has been already given. The phrase is ready-made, and the student has not had to process it in any way or introduce assumed knowledge as
he did in the previous example. In this case, there are only three component predications instead of four:

2. a. Type 3: Sentence 2 TIME Sentence 1.
   b. Type 3: The inhaling of air CAUSE Sentence 2c.
   c. Type 2: The lungs expand.

Thus, the number of deep-structure sentences, or predications, is intended to reflect the integrating and grammatical processing actually done by the student. In this sense, the results presented here are an analysis of process. The surface sentence with a number of underlying predications indicates that the student, in writing the sentence, pulled together a number of assertions. In the process of handling all of them, he might have changed some from assertive status to given status. He might have constructed the sentence so that some of the assertions were implicit and others explicit but expressed in a number of ways. But whatever the mode of expression, he was working, in some fashion, with a quantity of material. The label "predication load" seems apt, for the writer must carry a burden of content and relational information.

Illustration. The passage on the next page shows how the writer is required to, or manages to, handle quite a heavy load of predications in a longer piece of writing than analyzed thus far. The lead-in sentence, although it contains itself only a single type of information and a single predication, must be followed by sentences complex in meaning. The lead-in,

The digestive system has immune system components.

directs the writer not only to list some of these components but also
1) The digestive system has immune system components.
2) The surface layer of the alimentary canal, for example, has tight junctions between its cells so that no foreign material can enter via this route. 3) There are also cells among the epithelial cells which secrete mucus, trapping the invaders, and ciliated cells that move the invaders out to be swallowed and digested, or secreted. 4) All of these are physical barriers.
The digestive system has immune system components.

The surface layer of the alimentary canal has ... No foreign material can enter via this route.

There are cells among the epithelial cells. They secrete mucus. They trap the invaders.

There are ciliated cells. They move the invaders out.

The body swallows, digests, or secretes them.

These are called physical barriers.
to demonstrate their immune function, or in other words to show that they fight off harmful bacteria. To communicate these ideas requires two types of information, requiring the two different kinds of verbs. Having components is body-structure information; fighting bacteria is body-function information. In addition, the writer will have to show that the components he lists are meant to specify the general concept, "immune system components," and so he must provide a statement that shows the reader the SPECIFYing relationship. The types of predications included in each surface sentence are labeled Type 1 for information about the structure of the body, Type 2 for information about the function of the body, and Type 3 for relational information.

The second and third sentences SPECIFY the first as well as the fourth sentences. They are examples of immune components in the digestive system (Sentence 1) and they are also examples of physical barriers (Sentence 4). The third sentence is shown to be related not only to the first, by example, but also to the second by comparison. That is, Sentences 2 and 3 are similar because they have the same relationship to 1.

As it happens, the relational predications in this passage are all conveyed by single words ("also" and "all") or phrases ("for example"), or in the case of Sentence 3a the relation is implicit. In some other passage, however, these predications might have surfaced in the main verbs ("Muscle cells are examples of . . ."), and thus more obviously shown themselves to be sentences.

What is crucial is that the relational predications occur frequently and they are combined with information of other types. To
convey the Type 1 information that "the surface layer of the alimentary canal has tight junctions" requires in itself a small feat of memory, and some students took several sentences just to describe the structure of the layers of the long digestive tube. To convey both this information and the example relationship between this sentence and the first sentence is thus a double task. To make the task even more complicated, there is within the sentence a causal relationship between the tight junctions and the inability of the foreign material to enter. The information that the tight junctions kept out foreign material was crucial, for it demonstrated that the structural design of the cell was indeed related to its immune function. Without this link, the sentence as a whole would not have served its example function. But what makes the sentence complicated is also what makes it relevant—the combination of relational and other types of information.

Also important, but less so, is simply the number of predications per sentence. Notice the large number of predications—an average of five per sentence. Sentence 3 alone has nine predications, an unusually high number and not necessarily an indicator of higher quality than the other sentences. But a high average number of predications, between three and four per sentence—while less crucial than the presence of relational information—seems to characterize not only this passage but other well-integrated material in the study.

Incoherence: A Sample Passage/Analysis. The analysis is revealing for what it shows of student writing which is incoherent or very nearly so. The 13 sentences on the next page (analyzed on the following page) will illustrate the coherence problems of Jesus. Actually
Passage/Analysis 2: Jesus, Early Sample

Passage 2

1) The digestive system has immune system components. 2) These two systems of the body have different purposes and functions. 3) But one way or the other they are supplementary with each other in order to keep life continues. 4) The primary function of the immune system is to protect the body from infections and the digestive system is for the digestion of materials and absorption of nutrients. 5) When foods are taken into the body, they have to be digested, metabolised, absorbed, or discharged. 6) Not all the foods that are taken into the body are good. 7) These foods contain good materials which be absorbed and some are infectious to the body which we will refer them as antigens. 8) The immune system produces antibodies which kill those antigens to protect the body. 9) The digestive system is composed of the alimentary canal plus its derivatives and accessory organs. 10) Some of the immune system barriers which work in conjunction with or parts of the digestive systems are the glands, mucus, and sometime the spleen. 11) These glands and mucus membrane play an important part in the digestive system. 12) The glands secrete the hormones, mucus, and other components which help to initiate, run and complete the digestive system function. 13) The mucus contains antibodies which fight antigens and help to lubricate the foods.
Analysis 2

1. lead-in The digestive system has immune system components.

2. 1 1 a. Type 3 These two systems...have different purposes...
   b. Type 3 They COMPARE ("are supplementary with each other")

3. 1 2 a. Type 3 They COMPARE ("are supplementary with each other")
   b. Type 3 Sentence 3a CAUSE keep life continues

4A* 2 2 a. Type 3 The immune system CAUSE Sentence 4Ab
   b. Type 2 The body is protected

4B 2 2 a. Type 3 The digestive system CAUSE Sentence 4Bb
   b. Type 2 The body digests materials and absorbs nutrients.

5. 2 3 a. Type 2 The body takes in food
   b. Type 2 The body must digest, metabolise, absorb it
   c. Type 3 Sentence 5b TIME Sentence 5a

6. 1 1 a. Type 0 Not all the foods are good

7. 3 6 a. Type 0 Foods contain good materials
   b. Type 2 The body absorbs these
   c. Type 1 Some are infectious to the body
   d. Type 1 They are called antigens
   e. Type 3 Sentence 7a COMPARE Sentence 7c
   f. Type 3 Sentence 7 SPECIFY Sentence 6

8. 2 4 a. Type 2 The immune system produces antibodies
   b. Type 2 The antibodies kill those antigens
   c. Type 3 Sentence 8a CAUSE 8b
   d. Type 3 Sentence 8 SPECIFY Sentence 4a

9. 1 1 a. Type 1 The digestive system is composed of the alimen...

10. 2 2 a. Type 1 Some of the barriers...are the glands, mucus,...
    b. Type 3 Sentence 10 SPECIFY Sentence 1

11. 1 1 a. Type 2 These glands and mucus membrane play an impor...

12. 1 2 a. Type 2 The glands secrete the hormones, mucus, and...
    b. Type 2 They help to initiate, run, and complete...

13. 2 2 a. Type 1 The mucus contains antibodies
    b. Type 2 The antibodies fight antigens and help to lubri...

Number of sentences with relational information: 8 out of 13, or 61% of the sentences. (Sentence 1, the lead-in, is not counted.)

Number of relational predications: 11 in 13 sentences, or .84 per sentence.

Average number of predications per sentence: 28 in 13 sentences, or 2.15 per sentence.

* Note that independent clauses are treated as sentences. Sentence 4 thus is counted as two sentences.
the student is confused about what he is to do. Talk about any sort of relationship between the digestive and immune systems? Talk mainly about the immune system? Talk first about one and then the other? For this student from Micronesia, the first sentence did not direct him, as it did most of the group, to name immune components located in the digestive system and to show how they work.

Not only does the passage lack the sense of direction intended by the instructor; it also lacks a sense of direction imposed by the student. This is revealed by the lack of relational information in sentences 9, 11, 12, and 13. Up until sentence 9 the line of thought, although a bit slow in being established, nevertheless conveys the messages: The immune system protects the body and the digestive system absorbs the food. Not everything taken in by the digestive system is good. There are some bad things, or antigens. So the immune system produces antibodies, and the antibodies kill the antigens.

The sentences to this point generally carry the required types of information, though sentences 6 and 7, introducing "food" as a sentence topic, do not qualify as any of the three types and present a momentary puzzlement to the reader. But sentence 9 is information of only one type, Type 1, and thus does not meet the relevance requirement. For the reader who can ignore this sentence, sentence 10 is readable because it specifies the general concept of sentence 1, but many readers cannot ignore sentence 9 and they seek a relationship between 9 and 10. A break similar to the one caused by the irrelevance of 9 occurs at sentences 11 and 12. Here again, there is only one type of
information. By the time the reader reaches what would have been relevant information in sentence 13 (the antibodies fighting the antigens), he is unable to link this with the earlier information on the topic because the break has been too long. In sum, the passage is incoherent.

**Predication Loads for Six Students**

The hypothesis of information types describes and accounts for a variety of problems with coherence in the writing of the pre-medical group, and it provides a means for comparing one piece of writing with another. The precise indicators are these:

1. **the proportion of sentences that contain at least one relational predication** (This proportion also shows the proportion that contains none, for if 75 per cent contain at least one, then 25 per cent contain none.)
2. **the average number of relational predications per sentence**
3. **the overall average number of predications per sentence**

What does each of these measures indicate?

1. The fact that 100 per cent of the sentences in a given piece of writing contained relational information was characteristic of all the writing judged coherent. This was a good sign. It indicated that probably the writing was coherent (though not necessarily so, since the writing had to meet other conditions as well). Writing that did not have relational information in every sentence was almost certainly incoherent.
2) The average number of relational predications per sentence generally was interesting when the number was smaller than 1.00 per sentence. In other words, the difference between .12 and .75 was a revealing difference, indicating that the writer of the second piece (the .75) was probably making an attempt to integrate. An average of 1.00 was a borderline case. The well-integrated prose ranged from 1.50 on up, though averages higher than 1.50 did not indicate greater coherence.

3) A fairly high average number of predications, say 3.00 to 4.00, was characteristic of the passages judged coherent, though there were sentences with just two predications that were relevant.

The set of tables on the following page is actually a set of summary statements about the coherence of passages written by six students. The passages were produced on March 2 and on April 27. (The passages themselves together with the sentence analyses comprise Appendix C.) The tables correspond to the three measures just listed. One should keep in mind that incoherence is a function of low predicational load, and that, roughly speaking, it is reflected by low scores on the three tables.

For Rudy, the later sample is much improved over the early samples. (In his case there are two samples of early work.) The two pieces of early writing are both considerably below the point of having relational information in every sentence, but the later writing shows relational information in every sentence (Table 6) and an average of 1.14 relational predications per sentence (Table 7). The later sample shows an average 2.86 predications per sentence (Table 8) compared with the
### Table 6: Proportion of Sentences Containing Relational Information

<table>
<thead>
<tr>
<th>Character</th>
<th>Early Sample</th>
<th>Later Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rudy (sample 1)</td>
<td>50%</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>12%</td>
<td></td>
</tr>
<tr>
<td>Tomas</td>
<td>33%</td>
<td>100%</td>
</tr>
<tr>
<td>Carol</td>
<td>100%</td>
<td>75%</td>
</tr>
<tr>
<td>Tua</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Richard</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Jesus</td>
<td>61%</td>
<td>37%</td>
</tr>
</tbody>
</table>

### Table 7: Number of Relational Predications Per Sentence

<table>
<thead>
<tr>
<th>Character</th>
<th>Early Sample</th>
<th>Later Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rudy (sample 1)</td>
<td>.75</td>
<td>1.14</td>
</tr>
<tr>
<td></td>
<td>.12</td>
<td></td>
</tr>
<tr>
<td>Tomas</td>
<td>.40</td>
<td>1.50</td>
</tr>
<tr>
<td>Carol</td>
<td>2.20</td>
<td>1.25</td>
</tr>
<tr>
<td>Tua</td>
<td>1.43</td>
<td>1.43</td>
</tr>
<tr>
<td>Richard</td>
<td>2.00</td>
<td>1.50</td>
</tr>
<tr>
<td>Jesus</td>
<td>.84</td>
<td>.37</td>
</tr>
</tbody>
</table>

### Table 8: Number of Predications Per Sentence

<table>
<thead>
<tr>
<th>Character</th>
<th>Early Sample</th>
<th>Later Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rudy (sample 1)</td>
<td>1.87</td>
<td>2.86</td>
</tr>
<tr>
<td></td>
<td>1.25</td>
<td></td>
</tr>
<tr>
<td>Tomas</td>
<td>1.60</td>
<td>4.25</td>
</tr>
<tr>
<td>Carol</td>
<td>4.60</td>
<td>2.40</td>
</tr>
<tr>
<td>Tua</td>
<td>3.28</td>
<td>3.00</td>
</tr>
<tr>
<td>Richard</td>
<td>4.16</td>
<td>3.70</td>
</tr>
<tr>
<td>Jesus</td>
<td>2.15</td>
<td>2.37</td>
</tr>
</tbody>
</table>
very low 1.87 and 1.25 for the earlier samples. The writing of Tomas follows a similar pattern.

The coherence of the writing of Jesus, however, shows little real difference from one sample to the next. Numerically speaking, the difference between the earlier figures and the later ones is considerable (for example, 61 per cent compared with 37 per cent) but both figures fail to meet the required 100 per cent for Table 6. The same is true for Table 7: both samples are below the required 1.00. Though the overall number of predications (Table 8) is adequate for both samples, this fact alone is not sufficient cause for coherence. In short, the tables suggest that Jesus carried a good deal of Type 1 and 2 information—thus his sentences were complex—but that he failed to provide enough of the relational kind. His writing is a little different from the early samples of Rudy and Tomas, for theirs showed a generally inadequate load—too little complexity, too little load—while his lacked only relational information. Still, his case is not comparable to theirs, for they were apparently able to change and he was not.

As for the other three students, Richard, Carol and Tua, the writing for all of them meets the requirements for the first sample, although for the second one Carol's writing shows a slight decline. In this sample Carol shows relational predications in only 75 per cent of her sentences (Table 6), whereas coherence demands 100 per cent. As for Richard, the early sample and later sample show predication loads that are quite acceptably high. This fact fits with the impression given by his writing that he had successfully struggled with the
information, had it well under control, and could handle it in whatever combination was required by the assignment.

Those who had relational predications in every sentence (or 100 per cent on Table 6) generally had high levels of predications as well (Table 8).

<table>
<thead>
<tr>
<th></th>
<th>Table 6, early sample</th>
<th>Table 8, early sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carol</td>
<td>100%</td>
<td>4.60</td>
</tr>
<tr>
<td>Tua</td>
<td>100%</td>
<td>3.28</td>
</tr>
<tr>
<td>Richard</td>
<td>100%</td>
<td>4.16</td>
</tr>
</tbody>
</table>

But it was possible to have a high level of predications and not have relational information in every sentence. This combination produced incoherence:

| Jesus | 37%   | 2.37  |

This example supports the point made earlier. That is, a large number of predications was usually characteristic of coherent prose but did not necessarily create coherent prose. It was not a sufficient condition for coherence.

As for the very high predication loads, notice (Table 8) that both Carol (early) and Tomas (late) have a very high average number of predications. This fact indeed made for complexity of meaning but did not in itself make for such dense prose that it was difficult to follow. Nor did it make for a connectedness that was necessarily better than the average "good" predication loads of 3.00 to 4.00.

Rudy's early work is represented by two samples, one a chunk that imitates the introductory format. The other is a hodge-podge that is actually further down the developmental line, for the chunks
are shorter and the attempt is made now and then to pick up on all three types of information at once. The two samples of early work are included because the chunk-style shown by Sample 2 is an extreme form and not representative of Rudy's other early work.

There is, in fact, no claim that these passages accurately represent the quality of work the student was doing at that time of the semester. The number of sentences, for one thing, is not very large and not every essay was analyzed. For Rudy, Richard, and Jesus the passages are, in fact, probably quite representative, but there was nothing in the design of the study to insure that they were. The fact that the later sample for Carol is not quite as good as the earlier sample probably does not indicate a decline over time but simply that her performance was erratic. Tua's work was not always as coherent as the samples which were analyzed, and the later work of Tomas not always as coherent as his late sample indicates. The claim is not that the samples are representative of the student's general work, nor that these particular students represent the general population of college pre-medical students but rather that the figures in the tables accurately reflect important aspects of coherence.

Predication Load in a Complex, Professionally-Written Passage. The students' task was demanding because three types of information had to be integrated. But their task was not as difficult as it might have been. Other pieces of biology writing include still more information types, requiring more in the way of integration.

Such a piece of writing is a paragraph from the text, The Science of Movement by Tricker and Tricker. (See Passage/Analysis 3, later in
This chapter.) The paragraph covers much of the same ground covered by Rudy and the others on the topic of muscle contraction. Here again is the information about the structure and appearance of the cell—the bands, rods, and component pieces. Here is also the information about movement and function—sliding, moving, and contracting. But added to these two kinds of information are other strands of information, one about scientists and what they have done ("observed," "seen," "described," "shown," "stimulated," "identified," and "found"), another about scientists and what their attitudes have been (they "were reluctant," they "would have preferred"), another about what a theory "provides for," "is," or "suggests," and another about the author's evaluations. Add to these types the required relational type of information and the total is quite a number of types, each one of which is carried by the writer through a series of sentences. Again the types are sometimes differentiated by statal and dynamic verb types, and in addition they sometimes require different tenses and verbal aspects. The tense variable is something that did not arise for the pre-medical students because all their information types required the same tense, the timeless present (cells live, muscles are, etc.) But notice the variety of verb forms required by the author of this passage:

<table>
<thead>
<tr>
<th>Information types</th>
<th>Verb type</th>
<th>Aspects/tenses used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 1: Scientists do things</td>
<td>dynamic</td>
<td>the &quot;have&quot; aspect</td>
</tr>
<tr>
<td></td>
<td></td>
<td>past tense</td>
</tr>
<tr>
<td></td>
<td></td>
<td>present tense (this used</td>
</tr>
<tr>
<td></td>
<td></td>
<td>only for &quot;Reviews are</td>
</tr>
<tr>
<td></td>
<td></td>
<td>given by Huxley&quot;—a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>literary convention)</td>
</tr>
</tbody>
</table>
Information types | Verb type | Aspects/tenses used
--- | --- | ---
Type 2: Scientists had attitudes or capabilities | statal | past
Type 3: The body does | dynamic | timeless present
Type 4: The body is | statal | timeless present
Type 5: The theory is/ does | statal/dynamic | timeless present
Type 6: Relational | statal | timeless present ordinarily, one occurrence of the past
Type 7: The author evaluates | statal | timeless present

Not every type occurs in every sentence, but every type occurs with fair frequency and the relational occurs in every sentence. The inclusion of information about the attitudes and actions of the scientists would, in particular, add to the writer's difficulties, for this information requires a time-fixed verb (or "punctual" verb) instead of a verb of the timeless present. There are times when the verb has been deleted in the surface sentence, and such deletion simplifies matters somewhat. But the essential difficulty remains. How is one to talk about the sliding theory and what it says (and this is probably the author's main purpose) while, for purposes of accuracy, he must also say what scientists did and have done, also say what they felt, also what he himself feels, also say what the body is like and what it does, and also convey the relationships among all these pieces of information?

The writing of this paragraph requires consideration by the writer of seven types of information. The types are differentiated by type
of topic, type of verb, and various constraints or options regarding tense and aspect. Relational information is contained in every sentence in combination with other types. While not every type is contained in every sentence, still the writer manages to deal with an astonishing number of them in some of the sentences. Only the first and last and one other sentence are relatively simple, containing only two types. The other sentences contain three or four. Thus, the predication load—or the degree of integration—is very high indeed.

The significance of this integration, in terms of coherence and meaning, is that the reader senses the interplay of the various types of information. Almost simultaneously he reads about what scientists have done, what they thought, what the authors think, what the body is, what the body does, and various theories about muscle action. At least some of the types he introduces must be kept going for several sentences (not necessarily, but often, consecutive sentences). In this regard it is interesting that the information type, "actions of scientists," occurs in sentences 1, 2, 3, 5, 6, 7, 8, 10, 12, and 13. "Attitudes of scientists" occur in 8 and 9. The "structure of the body" occurs in 2, 3, 4, 5, and 6. The "function of the body" occurs—not so consecutively—in 2, 7, and 11. The "theory" occurs in 8, 9, 10, 11, and 12.

The passage and analysis follow:
Passage/Analysis 3: A Professional Sample

Passage 3 (from Tricker and Tricker, The Science of Movement²)

1) Various subdivisions of the striations have since been identified, of which the A, Z, I, and H are the most important. 2) In 1954, A. F. Huxley was able to show by stimulation with microelectrodes that the A bands move together on contraction of the muscle, reducing the width of the I band. 3) The advent of the electron microscope allowed greater powers of resolution, and further striking patterns were observed. 4) The cross-section is a regular pattern of dots which the longitudinal section shows to be bundles of rods. 5) The rods are of two types which have been identified with the two types of protein, actin and myosin, found in muscles. 6) The A band was found to be made of myosin, while the actin was present in all but the H band. 7) The sliding of one set of rods into the other accounts for both the contraction of muscle and the light microscope observations on the striations. 8) Some biologists were reluctant to accept this explanation, for no such mechanism had been encountered before in connection with living mechanisms. 9) Many observers would have preferred some coiling arrangement. 10) However, the sliding theory resulting from the elegant work of A. F. Huxley, R. Niedegerke, H. E. Huxley, and J. Hanson provides a very economical explanation of the observations. 11) It makes no pretense at describing how the contraction is made forceful, i.e., how the energy-rich chemicals convert their energy into a physical pull, but the ideas of some easily reversible bonding between actin and myosin may prove to be the answer. 12) Such bridges are, in fact, seen under the electron microscope. 13) More detailed reviews are given by H. E. Huxley, Sci. American, December 1965, and D. S. Smith, Sci. Am., June 1965.
### Analysis 3

<table>
<thead>
<tr>
<th>No. of types</th>
<th>No. of predications</th>
</tr>
</thead>
</table>
| 1. 2 2       | a. Type 1 The striations have been identified...  
               b. Type 7 These are most important  
               (This type does not occur again until Sentence 10) |
| 2. 3 7       | a. Type 6 Sentence 2 SPECIFY Sentence 1.  
               b. Type 1 Huxley was able to show...  
               c. Type 1 He stimulated with microelectrodes...  
               d. Type 3 The A bands move together  
               e. Type 3 The muscles contract  
               f. Type 6 Sentence 2d,e CAUSE Sentence 2g.  
               g. Type 3 The width of the band reduces |
| 3. 4 6       | a. Type 0 The electron microscope (came into being)  
               b. Type 1 It allowed (to scientists) greater powers...  
               c. Type 6 Sentence 3a CAUSE Sentence 3b.  
               d. Type 4 (the muscles showed) striking patterns  
               e. Type 1 These were observed  
               f. Type 6 Sentence 3 TIME/COMPARE Sentence 1, 2 ("further") |
| 4. 2 3       | a. Type 4 The cross section is a regular pattern of dots  
               b. Type 4 The longitudinal section (is) a bundle of rods  
               c. Type 6 Sentence 4a IDENTIFY Sentence 4c. |
| 5. 3 4       | a. Type 4 The rods are of two types  
               b. Type 1 These have been identified as the two types of...  
               c. Type 4 These are actin and myosin, found in muscles  
               d. Type 6 Sentence 5 SPECIFY NP in Sentence 4. |
| 6. 3 3       | a. Type 1 (Someone) found...  
               b. Type 4 The A band made of myosin, actin present in...  
               c. Type 6 Sentence 5 IDENTIFY Sentences 2, 1. |
| 7. 3 4       | a. Type 3 One set of rods slides into another  
               b. Type 6 Sentence 7a CAUSE Sentence 7c, d  
               c. Type 3 The muscles contract  
               d. Type 1 Striations by light microscope were observed |
| 8. 4 5       | a. Type 2 Some biologists were reluctant to accept...  
               b. Type 5 This (was) explanation  
               c. Type 6 Sentences 8d, e CAUSE Sentences a, b ("for")  
               d. Type 5 (This was) mechanism in connection with living...  
               e. Type 1 No such mechanism had been encountered |
9. 3 3
a. Type 6 Sentence 9 COMPARE Sentence 7
b. Type 2 Many observers would have preferred
c. Type 5 (The muscles) arranged in coil

type 10 6
a. Type 6 Sentence 10 CONTRAST Sentence 9.
b. Type 5 The sliding theory provides an explanation
c. Type 7 The explanation is economical
d. Type 1 Huxley, etc. (did) work
e. Type 7 The work was elegant
f. Type 6 Sentence d CAUSE sliding theory ("resulting")

11. 3 9
a. Type 5 It makes no pretense at describing how...
b. Type 3 The contraction (is) forceful
c. Type 6 (Something) CAUSE Sentence 11b ("is made")
d. Type 6 Sentence 1le SPECIFY Sentence b, c.
e. Type 3 The energy-rich chemicals convert their energy...
f. Type 6 Sentence g, h CONTRAST Sentence 11a ("but")
g. Type 7 Sentence 11h may prove to be the answer (Type 5).
h. Type 3 Bonds between actin and myosin easily reverse
i. Type 6 Sentences a,b,c,d,e CAUSE Sentence 10 (significance)

12. 3 3
a. Type 5 (These are) bridges
b. Type 1 These are seen under the electron microscope
c. Type 6 Sentences 12 a,b SPECIFY Sentence 11 ("in fact")

13. 2 2
a. Type 6 Sentence 13 CONJOIN above sentences.
b. Type 6 More reviews are given by Huxley, Smith, etc.

Number of sentences with relational information: 12 out of 12, 100%.
(The first sentence is not counted.)

Number of relational predications per sentence: 1.50.

Average number of predications per sentence: 4.58.
No one can know what the students in the study would have done if an assignment had demanded integration of this magnitude. Yet the evidence offered by their writing suggests three possibilities.

The first is that they might not have enough material at hand to integrate. Lack of content was the problem of several essays written by those in the low group (though not Passage 2 of this chapter written by Jesus). A common response was to write relevant remarks but without supporting detail.

The second possibility is that they would avoid integration. Like Rudy and Tomas in their early essays, the students would simply deal with one type of information, perhaps two types, but at any rate not the required combination of types. In fact, in another set of circumstances the requirement might have been different, allowing the student to deal with fewer types at a time. To tell the same story told by Tricker and Tricker, one could have begun with information about the way muscle cells look (structure, striations, component proteins, etc.) then continued with the way they work (sliding rods, attachment, release), then explained that this is a theory and that there are competing theories, then gone through a chronological series of discoveries by scientists, then gone on to the attitudes of the scientists toward one theory or another and their final preference (as well as the author's preference) for the sliding theory. There is only one reason why such a strategy of separation--separating one type of information from another--would not work for the pre-medical students. The constraints of the assignment, or the lead-in sentence, did not allow
it. These constraints had, in fact, been deliberately imposed so as to enforce integration.

The result of trying to separate was the chunk-style of writing. When the student, faced with the task of describing the effect of smooth muscle action on cardiac output, instead described the structure of smooth muscles, he produced an irrelevant chunk. The material itself was not irrelevant, but the task assumed by the student was not the assigned task. Instead of saying how the action of the smooth muscle made the heart put out more or less blood, Rudy described smooth muscle and then the action of the heart without focusing on the connection between the two pieces of description.

The third possibility is that students would successfully integrate the required types of information but in the process would produce sentences faulty in grammar and style. The writing of Jesus, where it carried predicate load sufficient for relevance, produced sentences with grammatical faults of one kind of another. Other students did likewise. How, when, and where such faults occurred will be the topic of the next chapter.
NOTES

There is one other kind of information that does not fit the categories, the information that the electron microscope came into being, but this type of information occurs only once. No doubt, occasional deviations of this kind can be tolerated.

CHAPTER 6
THE RELATIONSHIP BETWEEN HIGH PREDICATION LOAD
AND GRAMMATICAL ERRORS

When students carried high predication loads in single sentences, there was a marked tendency toward the making of grammatical errors. This tendency was noted earlier in the work of Rudy (Chapter 4). He had trouble when it came to saying that the existence of small structures in the digestive and respiratory tracts created a large surface area, which in turn allowed for the efficient exchange of gases or nutrients. The grammatical structure that gave him trouble was:

The more (something), the more (something)

This sentence is understandably difficult, for it is the expression of a very abstract notion: that one comparative relationship is causally related to another comparative relationship. One would suppose that in Rudy's case he simply had not had practice with this kind of structure.

The error he made in this grammatical structure is like a spelling mistake made by someone using a new word, or like the errors made by foreigners with such things as verb placement in indirect questions:

A. wrong: I wonder what is the question.
B. right: I wonder what the question is.

Or the placement of the auxiliary in negative constructions such as these:

A. wrong: Not only the kidney can absorb...
B. right: Not only can the kidney absorb...
These are developmental errors, meaning that their appearance signals some sort of progress in the achievement of an overall aim. When the child says "see'd" instead of "saw," the error in itself is thought to be less serious than the potential problem of never learning the rule for past-tense formation. The small error is tolerated for the sake of the larger learning. In the case of the writing student, the larger learning is the ability to consider the relationship implied by the "not unless" and "only when" or the different one implied by "not only."

The present study unfortunately can say nothing new about how such errors are best dealt with, whether it is best to leave them uncorrected on the assumption that the writer will somehow grow out of them as the child grows out of his grammatical mistakes, or to correct them on the assumption that adult language learners may never grow out of their errors without conscious learning and self-correction.

But what the study does show are several interesting patterns with regard to the errors. It also shows what seem to be gaps in the students' use of language to express relationships. In this chapter the problems encountered by the students will be listed and described under two headings: 1) Problems with the relational form, and 2) Problems with the non-relational form. It should be kept in mind that in this chapter all the student examples carry a high load of predications.
Problems and Uses of the Relational Sentence Form

The relational form caused trouble. Forms like

This is because of _________

or

_________ is like _________

require that content sentences be reduced so as to fit in the grammatical slots or the blank lines above. The main verb of assertion is taken up with its relational function, so the verb of the content sentence must either become the verb of a subordinate clause or even change itself into a noun. Consider the difference between

This is because _________

and

This is because of _________

Both of these require the reduction of content sentences to fit the slots, but the second of these is more constraining because the sentence to be embedded in the slot must be reduced to a nominal or to a noun followed by a relative clause. The first of these is easier to use because a full clause can be inserted in the slot.

Nevertheless both of these were cases where the relating task encouraged the student to use a sentence form that required grammatical manipulation of content sentences. The manipulation, in turn, offered the opportunity for making numbers of errors. Sometimes the errors were strictly grammatical—the failure to nominalize or make verbs agree with surface subjects—and sometimes they were errors involving simple precision or accuracy. The relational form makes rather difficult demands on its user in both respects.
Problems of preciseness. Writers wishing to express a complex analogy frequently say two things are alike when they are not alike, as in the sentence below:

These errors in development are like the child who uses "see'd" instead of "saw."

This statement is wrong. The errors are not like the child. Similarly, students produce sentences they would see, on closer examination, as factually wrong. They say an entire situation is an example of something, when only an element of the situation is the example. They say "This is because..." when they themselves are not quite sure what this is. These are problems of impreciseness.

These problems, whether they stem from language or thought or both, are not unlike those of math students who figure percentages. In doing the computation, the student may forget that his answer is really a per cent, or he may forget what it is a percentage of. He knows the principles of the operation but loses sight of them in the process of working with the numbers. To "know" is one thing, but the production of correct answers or meaningful prose may be quite another.

Carol and the Relational Form. In the case of Carol, the sentences below show the roughness of both language and thought that are the result of her very deliberate attempt to engage in the relating process. Every sentence below uses the relational form. The following is a typical problem sentence:

Some examples of physical barriers would be that all the epithelium of the mucus layer of the digestive system has tight junctions, which allows nothing to enter intercellularly, only through the epithelial cell, and the outermost cells are cornified.
What she has done is to use the relational form as the basic framework of the sentence, thus:

Some examples of physical barriers would be ________

Then to fill in the blank that is left, she uses an entire sentence instead of the noun phrase ("tight junctions") that is required. As a result, the referent of "which" (in the third line of the example above) is rather hazy. Is it "tight junctions," in which case the verb "allows" does not agree, or is it the preceding sentence, in which case the meaning is strange?

Carol's sentence is perfectly clear. Its relationship to what has gone before is well understood. But the structure is clumsy to say the least. The "for example" phrase would have been easier to use because it allows the example sentence to remain in its original form:

For example, all the epithelium of the mucus layer of the digestive system has tight junctions, which allow nothing to enter intercellularly.

Or, if the relational sentence form was important to the writer, then the subordinate sentence should have been modified:

Some examples would be the tight junctions of the digestive system's epithelial layer . . . and the cornified outer cells.

The rough splicing technique repeats itself almost exactly in the following sentences written by Carol:

a. One of these characteristics are skeletal muscles are multinucleated.

b. Another physical barrier is that among the epithelial cells there are cells which secrete mucus that traps the invaders with this sticky substance while the ciliated epithelial cells move the bacteria out to be swallowed and digested or secreted.
And in the following the clumsiness is exaggerated. What should have read:

The digestive system has immune system components. These are needed because the surface of the alimentary canal is the first thing an invading substance comes in contact with.

reads instead as:

The digestive system has immune system components. This is because it is considered an external surface in the tube within a tube body plan and is the first thing an invading substance will come in contact with.

Several elements having nothing to do with the causal relation clutter the sentence above and obscure the meaning. These elements are like vestigial phrases, left over from the sentence as it was probably learned from lecture notes. The phrase it is considered an external surface in the tube within a tube body plan really belongs to another set of information. In this case and in the others, Carol did not peel away the irrelevant part of the phrase and highlight what was most relevant.

Admittedly, it takes a good bit of skill to use the relational form when one must juggle information in itself complex. Carol's sentence about muscle cells, which follows, contains complicated ideas:

This is because they are long cells and because of this to keep the cytoplasm to nucleus ratio small, many nuclei are needed per cell.

The reader is invited to try for himself to rephrase, using the form, "This is because..." The version below, with which the present writer struggled, is only slightly better than Carol's:
This is because, being long cells with a good deal of cytoplasm, they need many nuclei to keep the cytoplasm to nucleus ratio small.

Carol writes much more easily when she does not feel constrained to use the relational form, as shown by the following sentence:

But in cardiac muscle cells there is only one nucleus because the cell is smaller and there is less cytoplasm to be controlled by the nucleus.

The Structure of the Main Clause. Sometimes the problem with the relational form was with the structure of the main predication, most commonly a problem for foreign students, though also for Rudy. How does one assert that something was the purpose of something, that something happens only under certain conditions, or that two things are similar? As straightforward as such ideas seem to be, students were unfamiliar, on occasion, with the required idiom. Just as Rudy had trouble with the construction, "the more . . . , the more . . .," students had trouble with the idiom used for purpose and contrast. The following, in some small way, are less than idiomatic:

The digestive system is for the digestion of materials.

The difference is due to the rate of contractions.

(Something) is somewhat directly proportional to (something).

Completing Comparisons. Richard, too, had trouble with this form, as shown by his failure to complete the comparison that is promised by the main clause below:

The difference between the two types of response is that the non-specific response reacts against any foreign molecule and prior exposure to the foreign molecule is not needed for the defense mechanism to work.
He must use another sentence to complete the comparison:

The specific immune response on the other hand requires previous exposure to the foreign molecule and specific sites on the molecule must be recognized for this defense system to work.

When a Noun, Not a Clause, is Required. The relational form could be better managed when the element that functioned as an example or a cause was a simple noun rather than a complex phrase or clause. Carol's sentence that follows is easy to read. In this case the simple noun needed for her construction does not have to be extracted from the sentence in which Carol learned it. Apparently, in her hierarchy of information it stands alone, not bound up in a clause structure as the "tight junctions" were bound up in an earlier example (p. 116).

An example of this is pancreozymin, which is secreted by the small intestine and has as its targets the smooth muscle cells of the gall bladder, the acinar cells of the pancreas, and the cells of the stomach.

The Relational Form as Starting Point. But for all the trouble caused by the relational form, it was clearly a device for helping the students to think. It was a means of keeping control of what was otherwise an unmanageable amount of information. In Carol's case, the relational predication was one of two starting points. The other starting point was a vocabulary of "superordinates" or general words such as systems, functions, and barriers, each one a class with various members. The superordinate word was used as the sentence topic, the relational information as the main predication. Her sentence construction suggests that she wrote this much before she thought about the rest of the sentence. One sentence begins:
Some examples of chemical barriers are . . .
"Examples" in the plural form and the verb "are" both anticipate more than a single example, but as it turns out, there is only one:

Some examples of chemical barriers are the varying pH in different parts of the digestive system.

**Relationships as Topics.** The sentence above reveals a real preoccupation on the part of the writer with relationships rather than with the context—the pH and what it was. Rudy would not have made the agreement error that Carol made in the example sentence above—the discrepancy between the examples promised and the single one delivered. His sentences were not about relationships but about the pH, or digestive layers, or muscle cells, or whatever. He did not, at least in his early essays, have the problem of finding a new verb to go into a newly constructed relational form. He simply used the original predication that came attached to the pH, the digestive layers, the muscle cells, and so on.

**Problems with Non-Relational Forms**

It is, of course, possible and perhaps even preferable to express relationships of cause, comparison, illustration, and so forth in ways other than the relational sentence. The relationships can be implicit. They can be expressed by short forms such as the adverbs "also" and "consequently." They can be expressed by subordinate clauses of one kind or another. So the form used for the expression of these relational ideas can be complex or simple.

But the students frequently chose the complex forms, and they chose to convey the ideas explicitly rather than implicitly. Carol's
work, shown above, was the most extreme in this respect, but there were others as well. One student almost invariably divided his material into three parts, each part an example of the main idea. The first sentence of each paragraph usually began: "An example of this is . . ." or "Another example is . . ." Like Carol, he used relating language deliberately and explicitly.

Failure to Use Short Forms. The relational forms students did not use were the single words or short phrases such as "similarly," "particularly," "for example," "on the other hand," or "as a result." It is interesting that Rudy, when he tried to use them in a very early piece of writing, made glaring mistakes. In the following sentence, "as well" is clearly wrong:

He finally narrowed it down to a proper concentration where curare would not cause death but would cause a sedative effect as well.

And in this one, the word "nevertheless" is wrong:

Bernard after becoming an intern showed a great deal of interest and enthusiasm in Magendie's experimental method approach on body physiology by participating in numerous Magendie research projects. . . Nevertheless, Bernard's future was greatly reflected by his acquaintance with his teacher Francois Magendie.

In this one it is the word "under":

. . . under response to sensory stimuli . . .

In general, Rudy was not completely in control of the language needed for conveying relational information in short form.

Richard used "on the other hand" and other short phrases, and he was quite good with words like "vary," which conveys contrast, and more than anyone else he made use of implicit relationships of contrast.
and generality. But the other students, including Carol and Rudy, made little use of the short forms for conveying relational information. Carol almost always failed to make it clear whether the word "also" went with the subject or the verb of the sentence. That is, if one says

The cardiac muscle also contracts rapidly
the context must make it clear whether one is comparing cardiac and skeletal muscles or listing a second attribute of cardiac muscle. In Carol's case, the word was often puzzling because one could not tell which meaning she had in mind.

**Failure to Delete.** Furthermore, in some cases some students failed to make use of very elementary linking devices such as pronouns. Rudy and Tomas, in particular, tended to repeat, long and laboriously, phrases that should have been deleted completely or replaced by pronouns. One example will suffice, this one produced by Rudy on the last essay of the semester:

Several systems are involved in the maintenance of salt and water balance. One system involved in the maintenance of salt and water balance is the urinary system.

**Failure to Form Relative Clauses Correctly.** Some students, Rudy in particular, were not familiar with the various means for forming relative clauses. Rudy, in fact, did not recognize the correct form when he had written it. The words he crossed out and inserted are as revealing in this case as in others. Having written the partial sentence:

There are also digestive hormones originating ...
he crossed off the -ing from "originating," added an -s and inserted a "that":

There are also digestive hormones that originates... In other words, he created an error instead of correcting one, for his result is less grammatical than the original. Having written this much, he continued with the sentence, attempting to embed the sentence: "They can act upon more than one target cell." But instead of using a relative pronoun, "which" or "that," he used the inappropriate "and." The entire sentence now contains two errors:

There are also digestive hormones that originate from the intestinal epithelium of the small intestine and can act upon more than one target cell.

On another occasion when the relativizing process is called for, he—not surprisingly—fails to make the verb forms parallel:

Another hormone which has more than one target cell and thus regulating more than one activity...

The following examples all show his considerable difficulty with the relativizing process:

1. He vastly improved his moral character as an extern under which was spent evenly in the hospital wards and the dissection rooms.

2. Bernard would collect this fluid from cadavers in which he invented a special technique for this purpose.

3. The discovery of a starchlike substance which is formed in the liver and it became regarded as the sole energy reserve in the body was done by Bernard.

4. He carefully studied curare toxicity and finally narrowed it down to a proper concentration where curare could not cause death but would cause a sedative effect...
Failure to Use the Characterizing Reference. Another effective relating device not used by the students was the characterizing reference. Or, to be accurate, it was used just a few times in the entire collection of essays written by the students, and these times by Tomas:

The retention of excess salt and water in the extracellular spaces is like drowning the cells. Such a metabolic accident must be avoided.

The "metabolic accident" is a reference to "drowning the cells" and yet it does more than refer; it makes an extra statement or predication. The sentence might read:

Such a metabolic accident--and this is what it is--must be avoided.

The referring phrase adds an item of information that the drowning is a kind of accident. The professional science writer Tricker, whose work was quoted in the last chapter, uses the device to good effect when he refers back to "some easily reversible bonding between actin and myosin" as "bridges" and when he refers to "the sliding of one set of rods into the other" as "this explanation." That the first process creates a kind of bridge and that the second is a kind of explanation is not obvious to the reader, and the information is helpful to him. The form of the characterizing reference makes it appear that the writer assumes reader familiarity with this information. In fact, it is new information to the reader, expressed in presupposed terms.

In general, one is impressed by the scarcity of sentences in the collection of data that expressed high predication loads (with relational information) in graceful forms. Richard, as suggested earlier, was the exception in the group. He could write sentences of this type...
with both grace and economy. The sentence below, for example, shows that cells are different from each other and that the differences have two sorts of causes, but that on the other hand, they have an important similarity. His sentence is simpler than the one just written describing it, yet it is fairly complex in structure: two independent clauses related by a comparison "but," a reduced relative clause ("depending"), and a complement structure ("in keeping"). The "in keeping" is less idiomatic than "to keep," but otherwise the sentence is clear and readable:

The cells of the endothelial lining vary depending on their location and function in the digestive tract, but they all serve in keeping undesirable foreign particles out of the body.

The Micronesian student, Tomas, was also writing by the end of the semester what seemed to be many sentences of the type that follows, sentences that are complex in form yet clear and readable. The first "this" refers to the preceding sentence.

This the body has to regulate so that its cellular activities, like the making of ATP and so forth, will not be hindered.

This sentence is complex in the sense that it contains a full adverbial clause ("so that SENTENCE") within which there is a nominalization ("the making of ATP").

In spite of what has been called here "failures," it must be kept in mind that it was a mark of progress for the pre-medical students to combine relational information with content information. To do so is generally something of a turning point for the student of so-called "basic" composition. The student's attempt to include comparisons,
causes, results, and generalizations frequently spells the difference between meeting the demands of academic assignments and not meeting them. The words "comparison," "cause," and "result" may be misleading, for actually the demand for this sort of thinking is a demand for imagination. The student is asked to juxtapose mentally several bits of data or fact and to come up with insights of his own. Admittedly the imagination is allowed short rein in some instances, such as in the writing under study here. Nevertheless every assignment that requires relational information asks the student to bring together parts of his experience that have not been brought together before. Each assignment asks him to examine their relationship and to describe it. When the bits of experience are disparate--like the sensations of feeling rain and touching silk--then the search for a relationship is what is more commonly thought of as an imaginative exercise. But to a degree it is also an imaginative exercise just to see the connection between absorption in one part of the body and absorption in another. To say that two body functions are similar in this respect is to reveal an insight of one's own. When students included relational information, this was evidence of such an imaginative exercise.
Summary

The investigation focussed on the writing skills shown by minority and Pacific Island students in an academic context. Eleven students, enrolled in a pre-medical special admissions review program, wrote essays once a week on topics from a biology course. Given a general lead-in sentence, they were asked to write the sentence and then to continue from that point, writing about two pages. Since the lead-in sentence applied to a great deal of material from the course lectures, they had the task of selecting material from a great mound of information, relating the material to the given sentence, and creating overall a piece of discourse that the reader could follow.

The students wrote these essays over the period of a semester, each week receiving returned carbon copies of their essays, which had been corrected in the fashion common to most composition classes. Grammatical errors were put right, and general comments were added in the margins and at the end. Three criteria were stressed: relevance to the lead-in sentence, quantity of detail, and correctness of the language. Together with the returned copy, the student received a written sample essay, showing how the essay might have been written or was written by another student. The dittoed sheet on which the sample was typed also included general remarks from the investigator about the progress of the class and showed the range of grades.

The purpose of the study was to examine writing skill outside the composition class in an environment where the information load is
great and students would be expected to have problems organizing it. The conditions under which the writing was done were desirable in view of this purpose. Lack of information was not a problem. All the subjects had access to the same information. And the basics of grammar were presumed to be familiar to the students, most of whom were in their sixteenth year of schooling. Even the non-native speakers were proficient in English grammar, or nearly so.

Aside from the "return" procedures described above and some conversation between the students and the investigator, there was no direct teaching of writing skills. The purpose was not to test a teaching method but to examine the skill or lack of skill shown by the students and to describe whatever changes might occur in their writing over the semester.

The particular writing skill under study was coherence, which is presumed to relate to several cognitive and verbal abilities. Although coherence is the quality of smoothness or flow which allows the reader to follow the writer, it is something more than the use of connective phrases. The production of coherent prose presumably engages the writer in complex cognitive and verbal processes. The object of the study was to discover ways of examining written prose so as to shed light on these complex processes. The need was for constructs that would allow one to describe a given piece of writing in a way that would describe the writer, or at least those aspects of his composing skill that have to do with forming connected prose.

The writing problems that motivated this study were those problems most commonly seen in academic writing done by students.
Students in college who write clearly and correctly in some instances write incoherently in the academic context. To derive constructs that would account for the problems of coherence of students in such a context would be of benefit to educators in the area of the teaching of writing. As things now stand, there is little to explain why writing for the same student is incoherent for the academic task but coherent for other pieces of writing. As a result, educators frequently misunderstand each other. The constructs they use to describe written products do not take into account the complexities of the task in which the student is involved.

Studies of coherence in the past have not focussed on the written text as having implications for the development of the writer, so have not been attuned to the difference between successful and unsuccessful attempts at creating coherent prose. The linguistics tradition has focussed on the link between meaning and form at the level of the sentence; the rhetorical tradition has focussed on overall conceptions of genre and the relation of genre to the writer and reader. Close textual analysis in the rhetorical tradition has gone either to scholarly work in poetry, drama, and novels or to paragraph analysis. In the case of paragraph analysis, the research has been concerned with the semantic connections of cause/effect, comparison/contrast, and so forth. Those in the rhetorical/literary tradition have done little to take advantage of the rigorous kind of analysis done by linguists, and until recently linguists have not tried to answer the important questions about semantic connectedness with which rhetoricians have been concerned. Recent work, however, has shown that the
application of methods worked out by linguists can be fruitfully applied to the analysis of texts.

Results of the study are presented in four parts.

1) Part of the findings of the present study were actually methodological. The methodological problem was one of relating data about the rhetorical function of a sentence (or a piece of a sentence)—these being labels such as "cause/effect"—to data about syntactic structures such as verb forms, relative clauses, nominal phrases, and so forth. Studies from linguistic research had shown that it was revealing to show various kinds of clauses and nominal phrases, as well as full sentences, as all being sentences at a deep-structure level. This level was useful for showing in an explicit way what it is that a listener understands even when part of what he understands is only implicit in the final utterance. To solve the present methodological problem there were good reasons to show semantic connections such as "cause/effect" also as being deep-structure sentences. These connections too are part—-an important part—-of what the listener or reader understands. Especially are such connections crucial in writing, where the writer cannot depend on the environment or interactive devices to make such links as example and significance clear. That something is an example, or that something is the significance of something else, are assertions that are frequently lost on the reader of student prose. As a consequence, the reader may not see the function of parts of the prose. If not, he views the writing as incoherent. It was important that the analysis differentiate
The arguments for claiming that such kinds of meaning should be represented by deep-structure sentences are like traditional linguistic arguments: The meaning has sentence form in some surface sentences (such as "This is an example of . . ."), and since this meaning is nearly the same as that expressed by the phrase, "for example," or the meaning implied in many contexts, then all these means of showing the same meaning should be represented as having the same sentence form at a deep level. Deep-structure sentences are merely a way of accounting for the similarity in meaning of the three kinds of forms. Because the data about rhetorical relationships such as "cause/effect" could now be seen in sentence form, it was possible to make important distinctions between sentences with linking functions and sentences with so-called "content" functions. To differentiate between "This is an example" and "This is an apple" is to recognize that the two kinds of sentences have very different functions, the first sentence having a linking function that the second does not have. What the second has is "content." This distinction was important to make and would not have been possible if linguistic methodology had not been applied to the semantic concerns of the rhetoricians.

2) The importance of the distinction was borne out by a study of the essays of two students whose cases were similar. A detailed study of one in particular showed that relational information like "cause/effect" constituted the difference between coherence and incoherence. Without such information—without the attempt to show that
certain material was an example or a cause--whole chunks of the students' essays appeared to be unrelated to the lead-in sentence. When such connective information was introduced, the reader could make more sense of the details provided.

One sensed in reading the work of these two students that it was their learning of content information that got in the way of coherent writing. Whole passages had been brought to the page straight from the lecture notes with little modification. Over the period of the semester there was a continual see-sawing between writing that contained mostly unmodified "chunks" and writing that showed more attempt to relate the various pieces of information to the main idea expressed in the lead-in sentence.

Of the two kinds of writing, the chunk-style writing was--on first reading--easier to understand and follow because the material inside the chunks was neatly structured by means of the repetition of grammatical elements, the structure being borrowed from the organization of the lecture or the pattern of certain portions of textbooks. (Textbook passages were examined for purposes of comparison with the student writing.) Such chunk-style writing was unacceptable, however, because the structure lacked the semantic or rhetorical links necessary for relevance to the lead-in sentence. The relationship between this material and the main idea was either non-existent or just missing for particular passages.

Progress toward more coherent writing was slow and difficult for these two students, particularly for the one whose work was studied in detail. His first attempts to include statements of relationship
led to writing that was nearly incomprehensible. He was apt to juxta-
pose relationship statements and content statements without modifying
the structure of the content statements. Later attempts were easier
to follow, but it was clear from the organization of the essays that
he did not perceive the writing task as did the skilled writers in
the class. Although he included information that specified, or other-
wise related appropriately to, the main idea, he included much irrelevant
material as well. His tape-recorded comments on this point show that
he considered information as belonging to block-like structures,
equipped with beginning, middle, and end. Through several assignments
he persisted in using the block-like structure when only selected
items from within the block were relevant. The last four assignments,
however, showed a competent grasp of skill with the organizing of
material so as to make clear the relationships between the pieces and
between them and the main idea. This writing was clearly coherent.

It was significant that the chunk-style pattern should be charac-
teristic of these particular two students. These two students were
members of what was termed the middle group--"high," "middle," and
"low" referring to scores on objective tests frequently given in the
course. Their status as middle group indicated that they were ahead
of those in the low group in terms of their mastery of the content
information, yet below those in the high group. The writing of the
low group would generally have to be described as coherent, and so was
the writing of the high group. But the middle group, in contrast with
the low group, used quantities of detail. The coherence of the writing
of the middle group suffered in the struggle by the writer to gain con-
trol of the detailed information.
As the writing of the middle group improved, it began to imitate that of the high group in the extent to which it integrated relational and content statements. It also integrated two kinds of content sentences as required by the assignment—"body structure" content and "body function" content. These two kinds of information differed in their syntactic properties. Although both used "the body" as the topic of the deep-structure sentence, one type used static verbs (like "state of being"), and one type used dynamic verbs.

3) A way to describe, in very general terms, the extent to which students integrated types of information was to use the construct predication load. The types were the three described above, two content types and one relational. Predication load was, in part, the number of deep-structure predications of each type expressed by each surface sentence. For example, the sentence

The body needs air.

is a Type 1 predication (static verb), but if the sentence is an example of some earlier statement, then it carries a relational predication (Type 3) as well. For any given surface sentence, both the number of types of predication and the number of predications regardless of type can be counted. Both are part of the predication load.

Samples of six students' work were analyzed for predication load in order to compare essays done two months apart. The analysis was done for two students from each group—high, middle, and low. As anticipated, the work of the high and low groups showed little variation, while the work of the two from the middle group showed a good
deal. For these two students the later sample showed an adequate load of predication, indicating that their writing was coherent. For the early essay the various measures of predication load (explained below) were too low. That is, there was not sufficient integration of information types. The low measure of predication load constituted incoherence; it also showed the reason for the problem or what had occurred in the composing process that led to this result.

Of the sentences judged coherent, all contained at least one relational predication (either implied or explicit). The average number of relational predications per sentence was actually somewhat higher than 1 in the coherent samples—sometimes 1.5 or higher per sentence. Figures higher than 1.5 did not make for "better" coherence, however. The number of predications regardless of type worked out to be an average of something greater than 3 for most coherent samples. There was, however, nothing wrong with the individual sentence with a load of 2. As for the number of types of predications, at least two were required for each sentence.

Incoherence was signalled by: a) sentences with no relational predication, b) sentences with only one type of information, and c) an overall average number of predications less than 2 per sentence.

4) Analysis of these samples (and some earlier data) showed that sentences with high predication load—that is, a high degree of integration of types—frequently were flawed by grammatical errors. Some students, of course, made fewer than others, but every person in the class who had managed to include the relational information necessary for maintaining coherence also made at least some errors
in forming sentences. To judge by the sentences produced by these students, there was a greater tendency towards error when the form of the sentence was relational, that is, when the relational predication became the main predication of the surface sentence. The following sentence (a correct one) uses the relational form:

An example of chemical barriers is the action of acids in the stomach.

When the relational meaning was shown in reduced form, the sentence was easier for the writer to handle and usually easier to read:

Acids in the stomach, for example, act as a chemical barrier.

Thus, for the subjects of this study the high predication load, which was necessary for meeting the demands of the assignment and without which the writing was incoherent, brought with it the opportunity for making increased numbers of errors in the construction of sentences.

Conclusions

One can draw several conclusions on the basis of the study, which are listed separately below even though they are interdependent.

1) High predication load was a feature of the academic writing tasks that were part of this study. As such, it helps to characterize not only these particular tasks but many of the assignments and essay examination questions given students at the college level.

2) High predication load made the task of creating coherent prose more difficult than it would have been if the load were lighter. The difficulty was felt, no doubt, by all of the subjects even though some of them handled it more successfully than others.
3) The predication load required by the assignments or carried by the student writer is describable in the numerical terms offered by the construct of predication load. The usefulness of the numbers, however, must be carefully qualified. They are useful mainly for purposes of clear communication because they show in simple summary fashion the "total" of several pieces of information. They are a measure derived from information about individual sentences as well as a group of sentences; they therefore reflect both the sentence and the passage levels. They are not useful, however, for large-scale assessment, for they are no more accurate for this purpose, and much more time consuming, than the intuitive judgments made by sensitive readers. Moreover, the numbers above certain values cannot be depended on for measuring increasing "quality." The numbers are useful merely for showing the presence or the absence of coherence, as it is operationally defined in the study. The construct itself is a qualitative rather than a quantitative measure; the numbers call attention to particular sentences or particular passages that may have gone wrong, help to explain the reasons for the problem, and suggest what the composing problem of the writer is.

4) When the predication load of the assignment is high, there are two types of composing difficulties inherent in the task. Roughly stated, the difficulties are in "integrative thinking" and "phrasing for correctness and readability." These are quite different problems, and it is possible for a student to have one and not the other. Yet there is a relationship between the two, for the students who have done the integrative thinking are more likely to have problems with phrasing
their sentences. In the case of students whose habits of integrative thinking change from poor to good, one can anticipate an increase in the number of grammatical faults.

5) The two types of difficulties call for quite different approaches in the teaching of composition, even when both problems occur—as they will—in the same classroom. Some student writers will not integrate material with relationships and others will produce incoherent prose because they have already integrated material. Whereas the first student will likely produce prose that seems too simple and the second will produce prose that contains errors of expression stemming from the complexity of idea, one can conclude that the two kinds of problems are related to a single phenomenon. One can conclude, in fact, that the two writers, under some conditions, may be the same writer at different stages of his development.

6) Generally speaking, the study argues for a developmental explanation of writing skills. It suggests that tests which purport to measure writing skill only show the skills of one student relative to another. They show little about where students stand, relative to themselves, on a developmental scale. The present study argues that complex tasks, being a necessary part of teaching academic subject matter, should have a place on this developmental scale. As students in the middle group changed their conceptions of what constituted the structure of the essays they wrote, so—no doubt—do children, picking up increasingly "adult" ways of structuring prose as they read an increasing variety of forms. Each time a student reaches for a more challenging and more complex way of writing, he revises his notions
of the function of the single sentence, for the single sentence functions in different ways in different environments. Teachers sometimes speak of teaching the structure of the sentence, or speak of students who have not learned how to write a sentence. But if "the sentence" were taught at grade 1, it would have to be retaught at each step of the writer's growth in order to keep him in step with his maturing sense of what is required by various kinds of discourse. Obviously, one never teaches "the sentence," but as an educator, one must expect new kinds of sentence problems to occur as developing writers take on writing tasks that are increasingly varied and, in some academic contexts, extremely complex.
CHAPTER 8
IMPLICATIONS FOR TEACHING AND RESEARCH

Developmental Writing in the Academic Context

In the subject-matter class, students write for the purpose of learning more about some aspect of the subject matter, of putting into practice some principle studied in the course, of simply reflecting on what has been learned, or in some way processing the information content of the course. Writing assignments are usually intended to serve the wide-ranging instructional goals of the course—the understanding of the political process, of the relation between history and culture, or of the systems of inquiry in the sciences. Writing assignments are ordinarily a chance for students to relate a bit of specific data to these more abstract concerns, which in turn relate to the students' own lives and experience. The object of the writing is to encourage the student to come to what is probably an old and familiar issue through the medium of some specific and concrete problem. The purpose is for the student to see the issue or idea in his own terms and his own language. Such was the purpose even for the pre-medical writing—the idea in this case being the amazing interdependency of the various mechanisms of the human body.

This part of the chapter will have to do with the subject-matter course and the concerns of those who must decide what the role of writing should be in the course, how the assignments should be set, and what to do with the writing after it is collected.

What the study suggests is that information types can be recognized not only in biology writing but in other kinds of writing as
well, such as the writing done for history or oceanography. Furthermore, the study predicts that the average predication load—the number of such types handled by the student in each sentence and then averaged for a given unit such as the paragraph—is a measure of the extent to which the student has tried to integrate. All the types of information in use must—more or less simultaneously—be moved forward. If more than three information types must be in use in the same sentence, then the task will be more complex than the biology writing examined for this study.

In the biology writing under investigation, information about body structure and function was all conveyed in the "timeless present." The events that occur in the body—the generic body and not a particular body—are not fixed to particular points of time. The events of history, by contrast, are so fixed. This fact introduces the need in history writing for variation in the tense and aspect of the verb. But, like biology writing, the writing done for history also makes use of verbs for both states of being and actions. Thus the writer must handle the variable of verb type. The picture is made more complicated by the fact that things happening ("things" being an inanimate topic) may be quite different from people doing things ("people" being an animate topic). Depending on the animate/inanimate variation, there may be different grammatical constraints on the selection of verb, though this question would require more investigation. One can predict that, at the very least, the following information types would be relevant to the writing of an essay about history:


1. What happened? (dynamic verb, past tense)
2. What had happened before this? (dynamic verb, past tense, perfect aspect)
3. What were conditions then? (statal verb, past tense)
4. What were other groups doing at the time of this event? (dynamic verb, past tense, progressive aspect)
5. What is/was true about this? (relational information--statal verb, present or past tense)
6. What has happened since then? (perfect aspect, present tense)
7. What happens nowadays or ordinarily? (dynamic verb, timeless present)
8. What happens under various conditions? (present tense, conditional mode)

The instructor setting the writing assignment for a history course has the responsibility for deciding which and how many of the above questions the students should deal with, and to what extent the various kinds of information should be integrated. The instructor or teacher who assigns writing can control the predication load the student must work with or carry. The way in which the load is manipulated would depend on the instructional goal of the instructor. He may want the student to presuppose familiarity by the reader with the data and content—in which case the student is assumed to be familiar with it too—and to make use of the writing exercise to write about the relationships between parts of the material. In this case the instructor can write the assignment so as to impose a heavy predicational load on the entire piece of writing. On the other hand, he may want the student to research new material and then to relate it to the principles of the course. In this case, the assignment would be written so as to
show that the paper would have two parts, one part a "telling" part in which the emphasis was simply on content and the predication load low, and one part a relational part, in which the predication load was high. In almost all course papers, the expectation by the instructor is that at least part of the paper will serve the purpose of relating and commenting on the other parts of the paper, although it is sometimes left to the student to decide whether this purpose will be served only in the last section or in the entire paper.

Finally, there are some cases in which instructional purposes are best served by writing that has no relational or integrative component at all. The following examples explore the differences between relational and non-relational assignments.

Relational Assignments, Heavy Predication Load. The following examples all fit the need for assignments with heavy predication load, or a heavy emphasis on relationships.

1. People have said that modern literature, TV, and drama are all sex and violence. Others say this is a natural reflection of the temper of the times. How do you explain the fact of obsessions of one kind or another in the work we have been reading? Why do you think writers write this way?

This question takes for granted reader familiarity with the text, but clearly the instructor wants the student to refer to events and people in the text. The main thrust of the question is relational: name reasons or causes, tell why. The other kind of information required here is information about people or events in contemporary times. In both the text and the real world, the information may be about things that happen or conditions that exist--adding two more information types
to the predication load. As a result, this question can be very complex. The developing writer will predictably answer the relational thrust of the question but not integrate it with content predications, either about the world or the text. Or, in the attempt to integrate, he may provide a "for example" but fail to pull from the example incident the relevant part—in which case the reader is left to find it for himself or miss the link altogether. It is to be expected that only occasionally will the student construct sentences that pull together content and relational predications (even implicit relational predications). When he does pull together such predications, the sentences will predictably be clumsily put together.

2. What does recent research in physics suggest about the atomic theory?

The answer to this question is a relationship—some recent research shows something—so in this case too the main thrust of the assignment is relational. Other information types will be these: What was the atomic theory? What is the modified theory? What did the researchers do? What were the results?

To integrate all of this information in single sentences will be next to impossible. The writer, even a very accomplished one, will be forced to separate types of information to some extent. Though he can begin with an integrated statement about what the recent research suggests, he will have to use some sentences just to say what findings the existing theory depends on, and what the recent findings were, before he can say how the recent research challenges the conventional theory and what it suggests in the way of a modified theory. For the
developing writer, it will be even harder to convey a sense of integration throughout the paper. Even if he is well organized and coherent, his essay may result in a three-part story of which only the third part seems connected with what goes before. In other words, of the following three parts, the writer will have trouble making links between the second and the first: 1) what the conventional theory is, 2) what the researcher did, and 3) the relationships between the findings and the theory.

Other assignments that require high predication loads are those frequently given on essay examinations:

3. Compare the English and French Revolutions in terms of their causes and effects.

4. Compare the three kinds of religions studied in this course with regard to doctrine.

Given the usual time allotment of 20 or 30 minutes to answer such questions, students who can manage any sort of integration are unusual. The developing writer will predictably give either a general answer of the relational kind, if he happens to remember similarities and differences from his notes, or he may avoid the relational altogether and write only information on the content level. There is usually not enough time for the student to review mentally the content material and arrive at his own relational insights. Thus the opportunity for the imaginative exercise of relating is ordinarily lost, even for those who ultimately come up with comparative statements. Giving questions of this kind requires the student to review too much content material in a short period of time. He will simply not do it; he will
use relational statements he remembers or has previously thought out, or not use them at all.

With all assignments in which the main thrust of the assignment is relational, instructors can expect sentence construction that is less than graceful, to say the least. Clumsiness can be expected, especially when the writer uses the form called here the "relational form":

This is because of (embedded sentence)
or

(embedded sentence) explains the (embedded sentence)

One can expect clumsiness and grammatical errors in the words that fill the blanks, assuming that the student has tried to fill the blanks with content statements. Even the student who can express relationships without the use of the relational form runs the risk of misusing the short forms, or words like "also" or "only," often misplacing them in the sentence (one of the traditional "misplaced modifiers"). Usually the most graceful way to show relationships is to make them implicit, but to judge by the writing in this study many students seem to lose control of their message when they do not use explicitly relating words or forms. Without the explicit marks of relationship, the material (for students at this level) has a way of going off on its own. That is, the student finds himself imitating whole structures of information that he has heard or read instead of pulling information out of these structures to use for his present writing purposes.
Non-relational Assignments, Low Predication Load

Perhaps there are instructional purposes best accomplished by writing assignments whose main thrust is not relational. For such an assignment the student's task would not be to show the relationships between bits of content with which the reader was presumed to be familiar. Rather the task would be to tell: to tell what happened, for instance, or to "introduce" something by way of the introductory form described in Chapter 3. The effect is a lower predication load, for the student can deal with only one kind of information, or perhaps two kinds, at once. Such a strategy allows for the separation of material rather than integration.

If, say, the instructor wanted the student to create a descriptive portrait of some sort, and the depth and intensity of this picture is the important goal--important both for the student to create it and to feel it--then a lower predication load can be imposed. Suppose, for example, the teaching purpose is point of view and the object is to have students select and reject information to fit the point of view. Then the following is well-suited:

1. Write a short biography of Henry VIII as though you considered him, in an affectionate sort of way, as the father of English traditions or culture.
   Write another portrait of him, this time showing him to be a cruel tyrant.

The parallel relational assignment, one requiring a higher predication load, is this one:

   For what reasons might the British today still feel affection for King Henry VIII, and for what reasons might they abhor his memory?
Another parallel set of assignments is this set:

2. [non-relational] Write a sermon as though you were Jonathan Edwards living in the 1920s.
   
   [relational] Contrast the 17th Century Calvinist values of Jonathan Edwards with the values of the 1920s (as expressed by the writers read for this class).

Another set is this one:

3. [non-relational] Tell what Huckleberry Finn did in some instance as though you were the Widow Douglas and knew what he had done.
   
   [relational] Contrast the values of Huckleberry Finn with those of the small-town Missouri society in which he lived.

The non-relational assignments above have a dramatic and imaginative purpose, but other non-relational assignments can be straightforward attempts to make possible relational thinking without relational writing. The following, for example, leads students into thinking about conflict in a literary work:

4. [non-relational] In every book there is a fight, a hostility, or just a tension of some sort. In the book you read, what (or who) was this "fight" between? What led up to it? Narrate, like a movie, the 60-second period of time that you think was the high point. Then tell what happened afterward, or how the whole thing was resolved or not resolved.

In this case, it is expected that the student will have understood the logical connections between early and late events and so will be able to select with sensitivity the events that were related to each other, but will be unable to say in any explicit way what the relationship was. He will be able to focus on the imaginative re-creation of the climactic scene and be able to retell it with good powers of memory. The assignment thus manages to engage his feelings in the notion of conflict and to exercise his powers of selection and re-telling.
To allow for separation in this way, even to allow for the avoidance of relational statements in some cases, is justified in terms of the instructional purpose. It allows for the sequencing of assignments from easy to difficult, it allows for greater emphasis on the visual, the narrative, the immediacy of the event, and the sense of "being there." In the science class, the set form of the lab report makes it easy to set down information that is in itself difficult or complex. The form separates one kind of information from another: 1) the general question or theory under study, 2) methods and procedures, 3) results, and 4) discussion. Only in the "discussion" section must the student integrate perhaps several information types. The other sections require only low predication loads.

**Relational Writing in the Large-Group Class.** But there are times when the instructional purpose suggests that the form of the writing must be integrative throughout. To try to relate information is an important intellectual exercise. Thus, to give assignments of the relational kind is important even when the class is very large and a sizeable minority has troubles with writing.

The professor of the subject-matter course who is willing to act on this belief should be forewarned. For the developing writer, the tendency is first of all to avoid the high predication load. And even when he manages to carry it, his writing may be phrased in clumsy or incorrect English. But the unpleasant experience of taking in and grading such pieces of writing ought to be worth it in the long run. The piece that is not a sensible communication should identify the student who has not yet made sense of the information. Writing may
be the only practice in trying to make sense of information that the student has. Others, unlike him, will take advantage of class discussion to do so, and still others will do so in "silent speech" or talking to themselves.

The case studies of Rudy and Carol suggest that what the instructor does with the writing should depend on the developmental level of the student. There are ways to treat different students on different developmental levels and yet be fair to all. There may be only a few in the group who are "ready" for the close textual criticism and suggested rephrasings that most professors feel obligated to write in the margins of student papers. Others may fall into two large groups, those who have too little material and those who have too little message. In either of these two cases, the predication load is too low. Those with too little material have either left too much empty space on the paper—in which case the student himself easily sees the problem—or he has included only relational information and too little information of other types. In such a case, "You need more material" is sufficient response from the instructor. Those with the problem that Rudy had include material in quantity but without relevance. They should be told that the reader "cannot see the relevance of the material to the question or first sentence." If time permits, the instructor or teaching assistant can underline the sentences that seem relevant. The important goal is for the student to begin to evaluate his writing for relevance.

In a sense, this kind of instruction is like moral or ethical teaching. The student understands what honesty is; he just has trouble
acting on the concept. But being reminded of it frequently, and having repeated tries at it, together with response from the observer ("Yes, you've got it . . . No, not this time") leads to learning. For the writing exercise to be an effective teaching technique, the student has to be reminded of the concept, to be told whether or not he has managed it, and allowed several tries in quick succession.

Even in the very large lecture class, e.g., say the required course in Western Civilization or General Science, students can be required to do a weekly piece of writing, short but very specific, requiring the student to pass judgment on some area of content or to relate various pieces of the content that had not been so related in class lecture. To spend 15 minutes of the discussion period in this way, or to require a single page of writing to be handed in, not only has the usual salutary effects on attendance, homework reading, and better discussion, but gives the student the extra chance to pull together the information.

Such tasks are not often given, first of all, because they are thought to take too much time to grade and return. In fact, grading should not take more than two minutes per paper, and perhaps even less if they are simply read and marked as suggested below. For those students who clearly deserve detailed margin comments, such comments could either be provided or not, depending on the time of the professor and teaching assistants. There are in some universities cooperating Writing Clinics that might be called in to do this kind of correction and editing.
Second, instructors feel that students who cannot write sensibly—that is, who show little control over the information—should not be judged in a subject matter course on their writing skill. Indeed, these writing exercises should not be weighted as heavily as other kinds of tests and not so heavily as to put the developing writer in jeopardy even if he fails on the writing exercise. At the same time, they should be weighted heavily enough to show the students the importance of being able to write about the subject matter.

What such a writing project would require in terms of course planning is two or three training sessions with teaching assistants (assuming a large lecture course) in which they would be taught to recognize the paper with low predication load versus the paper with high predication load and to separate the paper with poor phrasing but good predication load from the paper that seems to be correct but in fact has low predication load. Teaching assistants are understandably distracted from the student's message by the poor use of language, or they do not notice that though the language is smooth, the content is irrelevant to the question. With practice, however, they should be able to separate papers quickly into four piles: 1) those quite good on all counts, 2) those with high predication load but problems with phrasing, style, and grammar, 3) those with low predication load because the material is somehow off the point or not clearly related to the point, and 4) those with low predication load because the content level is low. Grades within these categories should be given, depending on the degree of the problem, but the categorization process on its own would make both student and instructor aware of the
student's position on the developmental scale. It would give the teaching team a practical way of evaluating progress, for the categories 4, 3, 2, 1 are arranged in order of student development.

Those with no content (4) are clearly worse off than those with grammatical mistakes (2). Those with correctly-written content but no attempt to make it bear on the question (3) are also worse off than those with just grammatical mistakes (2). (Of course students in categories 3 and 4 may also make grammatical mistakes, but this does not change their category. The prediction is that these writers will make even more mistakes when they begin to integrate material.) For a very quick measure of the progress of the class as a whole, the instructor keeps track of the numbers within each category and overall movement on the scale. This measure tells him how well the class is learning the difficult skill of using language for integration.

In addition to categorizing, the teaching team would need to work out a very quick way of handling the papers—collecting, returning, and recording—so that paper shuffling in itself would not be a burden. It can be annoying and self-defeating to use office space for a clutter of papers and class time for the passing of paper. Needless to say, for such frequent exercises the teaching staff should not be bothered with make-ups and student excuses for absences. The writing should be viewed, like class discussion, not as a test but as an important kind of verbal activity that both improves the student's abilities to handle the language and provides him a chance to integrate and "think about" the material of the course. There should be no problem that the exercise would be taken too lightly, for any writing is viewed by
most students as a rather frightening experience. They may, if given writing for homework, simply not do it at home. The advantage of in-class writing is that everyone produces. The disadvantage of class writing is the tendency to write before thinking. To discourage panic writing, students should be given a set amount of time to think or jot notes before being allowed to begin writing.

At first, the struggle to become familiar with new material may make it hard, if not impossible, to relate the material to that which is already known. The lack of relational ideas, in turn, may make whatever writing the student does seem incoherent. In the terms of this study, there will be too few relational predications. But the assumption behind the suggested weekly writing is that the exercise of writing encourages the students to produce the relational notions—and that if they do not at first produce them, they will begin to do so under the pressures of the continuing assignments. A greater number of relational predications will make the writing, by definition, more coherent.

Implications for Research

Several of the claims made in this chapter and the last one should remain open to investigation. One such claim is that information types parallel to those found in the students' biology writing will be found in student writing done for other disciplines. Another such claim is that writing containing high predication load can be distinguished by good readers from writing that (though coherent) contains a low load of predications. Both claims are easily investigated, the
first by paper and pencil analysis of student writing in, say, history, and the second by empirically matching the judgments of readers with the actual analyses of predication load. Both claims would need to be investigated before one attempted a large-class project such as the one just described.

The claim that assignments differ as to the predication load they impose should also be investigated. Such a project would require that different groups of students matched for writing skill do different assignments, and that the writing be evaluated for readability and correctness. The prediction is that assignments imposing lower predication loads, allowing for separation of information types and less relational information, would lead to writing that was more readable and more correct—and possibly less thought-provoking—than writing done for other kinds of academic assignments. It would also be interesting to see a wide-ranging survey of academic assignments, together with samples of prose written by the instructors for the purpose of showing what they expected students to write in response to the assignment. Both projects would have the purpose of exploring the question of the kind of thinking assignments are intended to encourage, and whether or not they do the job intended.

Another area of investigation is the whole developmental hypothesis argued in Chapters 4, 6, 7, and 8. Like many educators in the field, this investigator urges that long-term developmental studies be undertaken, especially of students who enter college unprepared to handle the complexities of both reading and writing about academic subject matter. In the basic composition course, such students seem
woefully unprepared, but do they in the course of the next year or
two pick up the verbal repertoire that seems to be required for pro­
cessing the quantities of complex information they are expected to
process? One can infer that Rudy, who still struggled with the basic
vocabulary of relationships, had made large gains over the previous
three years, and Tomas even greater gains. One would like to know how
great the gains were, and how far a late-beginning student can travel
if he is motivated. The use of the methodology worked out by this
study may be of some help in evaluating the writing done for long-term
studies of this kind, for it can help to explain the varying cognitive
load in various pieces of writing.

Another way to investigate the developmental implications of the
study is to carry out the project described earlier in this chapter,
monitor it carefully in terms of the progress of the students' coher­
ence and correctness, and relate this information to scores on
objective tests of the subject-matter content. To monitor would mean
to spot check the judgments made by the teaching assistants each week--
to analyze selected passages for predication load and match these
against the judgments of predication load made by the teaching assis­
tants--and to keep records of each student's score each week--that is,
a 1, 2, 3, or 4 as explained on p. 153. The prediction is that there
would be some movement upward over the weeks of the semester toward
more relevant and more detailed writing. Just what kind of movement
would occur, how much and by how many and for what reasons would be
the interesting questions. Such a project (the record-keeping would
be aided by computer analysis) would be expected to show movement over
time out of the 4 category (inadequate material) into higher categories--either the 3 category (material but without relevance to the main "message"), the 2 category (both material and message but problems with grammatical mistakes), or the 1 category (no problems with material, message, or grammar). If the findings of the present limited study are borne out, the writing of those who start in category 3 will move upward to 2 before reaching (if they reach) 1.

Important unanswered questions with regard to the developmental sequence have to do with its generality. What proportion of developing writers follow such a sequence, experiencing difficulties with grammar and sentence construction as they attempt greater integration? How many do not follow such a sequence? For example, how many take on the heavy predication load without attempts to avoid it? How many do so without showing difficulties with the grammatical construction of sentences? Such questions require investigation.

Finally, continued basic research in linguistics is necessary in order to discover more about the ways provided by the language for maintaining coherence. How writers make one sentence relate to what has gone before remains something of a mysterious process that contains both syntactic and semantic elements. How students acquire the means for creating coherence in the special language called writing is still an enormously complex question.
1This list looks something like Moffett's "universe of discourse." It shows that the distinctions between his various levels are paralleled not only by the variables of tense and aspect, which he pointed out, but also by the variable of verb type, statal and dynamic.
APPENDIX A Passage on Types of Muscles*

Seen under the microscope, muscle is divisible into two main categories, striated and unstriated. A third and more specialised type is cardiac muscle, found in vertebrate hearts, which is immune from fatigue. Unstriated muscle, otherwise known as smooth muscle, is composed of discrete cells, each of which contains a nucleus in the normal manner. Smooth muscle is relatively slow to act and is found in the gut and bladder of vertebrates. In the gut it normally has an innate rhythm whose rate overall, rather than each individual contraction, is controlled by the nervous system. Such a rhythm is shown in Plate V (i) which was drawn on a revolving drum by a lever attached to an isolated piece of the gut of a worm. This preparation had no nervous input. Smooth muscle can exert a very large force for long periods in the closure of some mollusc shells, like the mussel. It seems that these muscles must be able to lock themselves in the contracted state, for they require little more energy than when they are resting.

Muscle cells are cells specialized for contraction. Muscle cells can also be called muscle fibers. These fibers run longitudinally and parallel among each other. These muscle fibers constitute muscle bundles. The latter also run longitudinally and parallel among each other to form the muscles of the body.

There are three different types of muscles in the human body. These three types are cardiac, smooth, and skeletal muscles. These muscles are different among each other due to location and physical appearances.

Smooth muscle can be found in the lining of the digestive system, respiratory system, and also in the excretory system. Smooth muscle fibers are under involuntary control of the autonomic nervous system. Smooth muscle fibers have longitudinal striations, but no cross striations. The width of smooth muscle fibers are very narrow, much narrower than the other two types of muscle. It has also a centrally located nucleus.

Cardiac muscle can be found in the lining of the heart. Cardiac muscle is also under involuntary control of the autonomic nervous system. These muscle fibers have longitudinal striations and cross striations. They also have a centrally located nucleus, sometimes there can be two nuclei instead of one. The width of the muscle is a little wider than of smooth muscle.

Skeletal muscle makes up the bulk of the body muscle framework. These muscle fibers are connected to tendons which in turn is connected to the skeletal system. These muscle fibers are under voluntary control (etc.)
Muscle cells transform chemical bond energy into mechanical work. The chemical bond energy comes from the breaking of the high energy phosphate bonds of ATP or adenosine triphosphate during muscle cell contraction.

There are several ways of generating ATP or producing ATP for muscle contraction. Normally the production of ATP is found to occur within the cytoplasm of a cell and also within the mitochondria of the cell. If ATP is produced within the sarcoplasm of a muscle cell, it is normally ATP production from glycolysis. If ATP is produced within the muscle cell mitochondrion, it is called oxidative phosphorylation. Besides glycolysis and oxidative phosphorylation, ATP can also be produced from phosphagen pools, such as creatine phosphate and orginine phosphate. These phosphagen pools are also found within the muscle cell sarcoplasm.

In order to produce ATPs from glycolysis and oxidative phosphorylation, the presence of glucose molecules are needed within the muscle cell sarcoplasm. Glucose molecules are carried in the blood and are stored in these muscle cells in the form of glucose polymers called glycogen. Within the sarcoplasm of the muscle cell are certain enzymes which breaks down glycogen into individual glucose molecules. These molecules then goes through glycolysis and later on, they will go through oxidative phosphorylation.

A single glucose molecule that goes through glycolysis will produce two ATP molecules. Glucose is transformed into pyruvate at the end of the glycolytic pathway. Pyruvate can then diffuse into the muscle (etc.)
Certain characteristics contribute to important functional differences between cardiac and skeletal muscle are primarily related to the movement of certain intracellular and extracellular inorganic ions. The primary functional difference between skeletal muscle and cardiac muscle is due to the rate of contractions. The rate of contraction of skeletal muscle is much slower than the rate of contraction in cardiac muscle. The rate of contraction in muscle cells are directly influenced by the permeability of the muscle cell membrane to certain ions. The change of the muscle cell membrane permeability, as a result of nerve stimulation, can cause an action potential to be generated throughout the cell membrane. The magnitude of the action potential is somewhat directly proportional to the rate of contraction. The principal inorganic ions which plays an important role in muscle contraction are calcium, sodium, and potassium. Potassium is the principal intracellular ion, sodium is the principal extracellular ion and calcium is an important ion that promotes muscle contraction.

In order for muscle contraction to occur, there must be an action potential or transmembrane potential generated throughout the membrane. The inflow and outflow of these principal intra- and extracellular ions largely determine the magnitude of the action potential. Both cardiac and skeletal muscle action potentials have similar aspects. After nerve stimulation, acetylcholine from the nerve fiber, tend to diffuse across the myoneural junction and combine with the muscle fiber membrane. This combination or attachment of acetylcholine with the muscle fiber membrane will cause a structural change or a change in the permeability (etc.)
Smooth muscle action affects cardiac output. Smooth muscle is primarily found in the lining of the heart and blood vessels. The smooth muscle which affects cardiac output the greatest is found in the lining of the heart.* Smooth muscle which is found in the lining of blood vessels also effects cardiac output but to a lesser extent than cardiac smooth muscle.

Cardiac output is the amount of blood that leaves the left ventricle of the heart in a certain amount of time. The cardiac output of humans is normally about five liters per minute. Besides the effect of smooth muscle upon cardiac output, there are other factors which can also vary the rate of cardiac output. The cardiac cycle consist of four phases. The action of smooth muscle or the physical activity of smooth muscle effects all four phases. However, the phase of the cardiac cycle, in which the action of smooth muscle effects the most, is during the early portion of the systolic phase. That early portion of the systolic phase is known as the isovolumic contraction period. During this period, the ventricles of the heart are filled with a certain amount of blood. Inorder to pump the blood out of the ventricles, contraction must occur within the ventricular walls. The contraction of the smooth muscle within the walls of the heart ventricles is a certain type of muscle contraction. This type of contraction is called isometric contraction. Isometric contraction is the contraction of muscles at a fixed or constant length. The contraction of the smooth muscle (etc.)

* Rudy has confused cardiac and smooth muscle, a mistake which may have thrown off this entire essay.
The digestive system has immune system components. These immune system components are found in the walls of the alimentary canal. The walls of the digestive system consist of four distinct layers. The four layers are mucosa, submucosa, muscularis externa, and adventitia or serosa. Primarily, the immune system components are found only in the mucosa, and submucosa layers.

The mucosa layer of the digestive tract is comprised of three layers. The mucosa layer is the innermost layer of the four distinct layers. It is the layer that is closest to the lumen of the digestive tract. The three layers which constitute the mucosa layer are, epithelial cell layer (innermost), lamina propria (middle), and muscularis muscosae (outermost, adjacent to the submucosa). The lamina propria contains the major immune system components of the mucosa. In the lamina propria, there are lymph nodes, accumulation of white blood cells, and also loose connective tissue. The lymph nodes in the lamina propria produces the major specific immunological cells such as T-lymphocytes, B-lymphocytes, and plasma cells. These cells participate for the specific immune defenses of the body. The principal white blood cells found in the lamina propria are monocytes, eosinophils, and basophils. These cells participate for the non-specific immune defenses of the body.

The submucosa is the next layer adjacent to the mucosa layer. This layer consists of dense connective tissue and also accumulation of lymphoid tissue. These lymphoid tissue are responsible for processing specific immunological cells. These specific immunological cells (etc.)
APPENDIX B  
Rudy, Essay 6 (portion)

Increased surface area is important for the function of both the respiratory tract and digestive tract. The exchange of carbon dioxide and oxygen will take place efficiently over a large surface area of the respiratory system. The exchange of nutrients, vitamins, and water will also take place efficiently over a large surface area of the digestive system.

Primitive unicellular organisms did not have a respiratory tract and digestive tract. However, their exchange of gases, liquids and nutrients took place over a large surface area in an aqueous medium. The necessary gases, nutrients and liquids passively and actively diffused over a large surface area from the external aqueous medium into the internal intracellular aqueous medium. As evolution proceeded on, the volume of the organism increased, therefore the surface area increased, but not as great as compared to volume increase. This process of volume to surface area ration finally reached a point where specialized body components were needed in order to maintain digestion and respiration properly. These specialized body components are invaginations and evaginations of the respiratory and digestive system endodermal lining.

It is very important to have a large surface area in the respiratory system, in order for gas exchange to take place properly. The respiratory system increased its surface area by developing an abundant number of ducts called alveolar ducts. The walls of these ducts has numerous outpocketings or bubbles called the alveolus. The primary site of gas exchange occurs in these outpocketings or alveolus. (etc.)
A hormone may have more than one target cell and thus regulate more than one kind of activity. Digestive hormones are good examples that act upon more than one target cell and thus regulating more than one kind of activity. These digestive hormones are found to originate particularly in the stomach and the small intestine epithelial lining.

In the stomach lining, there are submucosal glands which contain certain endocrine cells. These endocrine cells are called argentaffin cells and they secrete the hormone gastrin. Gastrin is dumped into the blood immediately after secretion and it travels through the bloodstream toward its specific target organs. Gastrin can stimulate the parietal cells that are found in the stomach lining. Following stimulation, these parietal cells start to synthesize inactive enzymes such as pepsinogen and renninozin. These enzymes will become active when they come into contact with hydrochloric acid in the lumen of the stomach. Gastrin not only can stimulate parietal cells of the stomach, but it can also stimulate the pancreas ocini cells to release sodium bicarbonate into the duodenum of the small intestine. Sodium bicarbonate can act as a buffer in the small intestine by neutralizing the hydrochloric acid which is contained in the partly undigested food that comes immediately from the stomach.

There are also digestive hormones that originates from the intestinal epithelium of the small intestine and can act upon more than one target cell and thus regulate more than one kind of activity. These digestive hormones are secreted by the mucosal glands of the small (etc.)
The endocrine and nervous systems can be considered a single control system. The endocrine and nervous systems are interconnected to one another and through combined functions, both systems contribute greatly to body homeostasis, integration and morphogenesis. Both systems can act concommittantly to carry out numerous vital body functions in time of stress, fright, temperature changes, growth, etc.

In order for the certain endocrine system to take its effect in the body, it must need nervous input or nervous stimuli. Usually the stimuli can have an internal origin or an external origin. External stimuli and internal stimuli both stimulate sensory receptors which are either located in the body periphery or in the body visceral organs. When this stimulus occurs, a nerve impulse is generated in the central nervous system which is the brain and spinal cord. The brain will manipulate the nervous impulse information and later it will conduct its own impulse toward a specific body organ which will respond specifically to the brain impulse information and later the organ will do something to meet the stimuli needs, either it will be secretion of a hormone, or contraction of a muscle fiber.

The impulse which comes from the brain will stimulate certain neurons or cell bodies. These neurons will then undergo depolarization, specifically the axon of a neuron. The neuron produces neurotransmitters such as acetylcholine and also they contain neurohormones such as norepinephrine and serotonin. Following depolarization of the neuron axon, these neurotransmitters and neurohormones are released and they travel through a synaptic cleft and attaches to the target cell (etc.)
Several body systems are involved in maintaining salt and water balance. These body systems are in turn regulated by the endocrine and nervous systems. The endocrine component which is involved in maintaining salt and water balance is the adrenal glands and the neuroendocrine component is the hypothalamus. Both components under the response to sensory stimuli, will release a specific hormone and neurohormone that will take its effects primarily on the kidney. The kidney itself has a system for maintaining the osmolarity of body fluids.

Sensory receptors that are located in the walls of the internal carotid blood vessel and also the left atrium are able to monitor the serum tonicity of the blood. During an accident when there is huge amounts of blood loss, the blood pressure will decrease. The sensory receptors senses the low blood pressure and sends nervous stimuli to the hypothalamus which in turn generates a nerve impulse to the posterior pituitary. At the posterior pituitary, nervous stimuli will cause the release of the neuroendocrine hormone called vasopressin or anti-diuretic hormone. Vasopressin will then act upon the epithelial cells of the collecting ducts to reabsorb more water from the filtrate urine into the blood. As a result, blood pressure is restored to normal.

A specific hormone that is produced in the adrenal cortex and is called aldosterone will also regulate salt and water reabsorption in the kidney. Aldosterone will stimulate the epithelial cells of the distal convoluted tubule to reabsorb sodium. When this occurs, the interstitium will become highly concentrated and will cause the water from the urine to passively diffuse into the interstitium (bloodstream).
Another system that involves water-salt balance is the rennin-angiotensin system. When a hemorrhage occurs, extreme blood loss will occur also, this leads to a decrease blood pressure. Certain kidney cells called the juxtaglomerular cells monitors the blood pressure of the blood. When the blood pressure is decreased, these cells will secrete a specific enzyme called rennin into the blood. Rennin will then activate a precursor hormone called "angiotensinogen" (produced in the liver) to angiotensin. Angiotensin can then act as a vasoconstrictor. When the blood vessels become constricted, this causes a decrease in hydrostatic pressure in the arterioles of the kidney nephron. As a result to decrease hydrostatic pressure, sodium and water will move from the filtrate and back into the arterioles, thus restoring serum blood pressure.

The systems that are involved in salt and water balance deals entirely on the concept of osmolarity in the blood. Changes in blood pressure triggers the release of specific hormones that can act upon the tubular epithelial lining of the kidney to reabsorb sodium and water in order to restore blood pressure and body fluid balance. The nervous and endocrine systems plays an important role by regulating the salt and water reabsorption function of the kidney.
APPENDIX C

Passage/Analysis 4:

Richard, March 2 (early sample)

Passage 4

1) The digestive system has immune system components. 2) It involves both the specific and non-specific immune response. 3) The difference between the two types of response is that the non-specific response reacts against any foreign molecule and prior exposure to the foreign molecule is not needed for the defense mechanism to work. 4) The specific immune response on the other hand requires a previous exposure to the foreign molecule and specific sites on the molecule must be recognized for this defense system to work.

5) The non-specific immune response of the digestive system involves three major types of barriers: physical, chemical, and ecological barriers. 6) Physical barriers involve the lining of the digestive tract, from the mouth to anus, which is an endothelial lining derived from endoderm. 7) The cells of endothelial lining vary depending on location and function in the digestive tract, but they all serve in keeping undesirable foreign particles out of the body.
APPENDIX C

Analysis 4

1. lead-in
   The digestive system has immune system components.

2. 2 3
   a. Type 2 The specific response is involved
   b. Type 2 The non-specific response is involved
   c. Type 3 Sentence 2a COMPARE Sentence 2b ("both")

3. 2 6
   a. Type 2 The non-specific response reacts against any
   b. Type 2 Prior exposure (by the body) to the foreign...
   c. Type 3 The two types of response COMPARE ("differ")
   d. Type 2 This defense system works
   e. Type 3 Sentence 3b (not needed) for CAUSE Sentence 3d
   f. Type 3 Sentences 3a,b,c,d,e SPECIFY Sentence 2

4. 2 5
   a. Type 3 Sentence 4b COMPARE Sentence 4c
   b. Type 2 Specific immune response requires a previous
   c. Type 2 Specific sites on the molecule must be recog...
   d. Type 3 Sentence 4c CAUSE Sentence 4e
   e. Type 2 This defense system works

5. 2 2
   a. Type 3 Sentence 5b SPECIFY Sentence 2
   b. Type 1 The non-specific immune response is three...

6. 2 3
   a. Type 3 Sentence 6b SPECIFY Sentence 5
   b. Type 1 The barrier (is) the lining of the digestive
   c. Type 1 This is an endothelial lining derived from

7. 3 6
   a. Type 3 The cells of endothelial lining COMPARE ("vary")
   b. Type 3 Sentence 7c CAUSE Sentence 7a
   c. Type 1 (The cells have) location and function in the...
   d. Type 3 Sentence 7a COMPARE Sentence 7c
   e. Type 3 Sentence 7f GENERALIZE
   f. Type 2 They keep undesirable foreign particles out...

Number of sentences with relational information: 6 out of 6, 100%.
Number of relational predications per sentence: 2.00.
Average number of predications per sentence: 4.16.
Passage 5

1) Several body systems are involved in maintaining salt and water balance. 2) They include the digestive system, the urinary system, and the skin's secretary system. 3) All of these systems involve the secretion of sodium ions since sodium is the major determining ion that causes water to flow across cell membranes. 4) If sodium salts are secreted, water follows. 5) That is the law of osmotic transport.
APPENDIX C

Analysis 5

1. lead-in
   Several body systems are involved in maintain...

2. 2 3
   a. Type 3 Sentence 2b SPECIFY Sentence 1
   b. Type 1 They are the digestive system, the urinary...
   c. Type 1 The skin has a secretory system

3. 2 5
   a. Type 3 Sentence 3b GENERALIZE Sentence 2
   b. Type 2 They involve secretion of sodium ions
   c. Type 3 Sentence 3d CAUSE Sentence 3b
   d. Type 3 Sodium CAUSE Sentence 3e
   e. Type 2 Water flows across cell membranes

4. 2 3
   a. Type 3 Sentence 4b CAUSE Sentence 4c
   b. Type 2 Sodium salts are secreted
   c. Type 2 Water follows

5. 2 2
   a. Type 3 Sentence 5b GENERALIZE Sentence 5a
   b. Type 1 This is the law of osmotic transport

Number of sentences with relational information: 4 out of 4, 100%.

Number of relational predications: 6 in 4 sentences, or 1.50 per sentence.

Average number of predications per sentence: 3.70.
APPENDIX C

Passage/Analysis 6:

Carol, March 2 (early sample)

Passage 6

1) The digestive system has immune system components. 2) This is because it is considered an external surface in the tube within a tube body plan and is the first thing an invading substance will come in contact with. 3) The primary line of defense or first component of the immune system an invader would meet would be physical or chemical barriers. 4) Some examples of physical barriers would be that all the epithelium of mucus layer of the digestive system has tight junctions which allows nothing to enter intercellularly only through the epithelial cell, and the outermost epithelial cells are cornified.

5) Another physical barrier is that among the epithelial cells there are cells which secrete mucus that traps the invaders with this sticky substance while the ciliated epithelial cell move the bacteria out to be swallowed and digested or secreted.

6) Some examples of chemical barriers are the varying pH in different parts of the digestive system.
APPENDIX C

Analysis 6

1. lead-in Type 1 The digestive system has immune system compo...

2. 3 4 a. Type 3 Sentence 2b,c CAUSE Sentence 1
b. Type 1 It is an external surface in the tube within...
c. Type 2 An invading substance will come in contact...
d. Type 3 (The digestive system) COMPARE ("is first")

3. 2 4 a. Type 1 The immune system has a line of defense and...
b. Type 3 Sentence 3d COMPARE ("primary" or "first")
c. Type 3 Sentence 3d SPECIFY Sentence 1
d. Type 1 (there are) physical or chemical barriers

4. 3 5 a. Type 3 Sentence 4b SPECIFY Sentence 3d
b. Type 1 All the epithelium ... has tight junctions
c. Type 3 Sentence 4b (NP) CAUSE 4d
d. Type 2 Nothing enter intercellularly, only through...
e. Type 1 The outermost epithelial cells are cornified...

5. 3 8 a. Type 3 Sentence 5b SPECIFY Sentence 4NP
b. Type 1 There are cells among the epithelial cells
c. Type 2 The cells secrete mucus
d. Type 2 The mucus traps the invaders with this sticky...
e. Type 3 Sentence 5c,d TIME Sentence 5e,f
f. Type 2 The ciliated epithelia cell move the bacteria...
g. Type 3 Sentence 5e CAUSE 5g
h. Type 2 Bacteria are swallowed and digested or...

6. 2 2 a. Type 3 Sentence 6 SPECIFY Sentence 3NP
b. Type 1 pH (is in) different parts of the digestive...

Number of sentences with relational information: 5 out of 5, 100%.
Number of relational predications per sentence: 2.20.
Average number of predications per sentence: 4.60.
APPENDIX C

Passage/Analysis 7:
Carol, April 27 (later sample)

Passage 7

1) Several body systems are involved in maintaining salt and water balance. 2) This balance is necessary in maintaining homeostasis, a necessary condition for survival. 3) Probably the main system with which all the other body systems help to accomplish this balance is the urinary system. 4) The main organ of this system is the kidney which is made up of precisely arranged nephrons and a collecting system specialized to maintain salt and water balance around a set point. 5) A quarter of the cardiac output is filtered through the glomerulus of the kidney which is situated in Bowman's capsule.
Several body systems are involved in maintaining homeostasis. Homeostasis is the necessary condition for maintaining this balance. The system under consideration is the urinary system. All the body systems help to accomplish this. The main organ of this system is the kidney, which is made up of precisely arranged structures. The collecting system maintains salt and...
1) Smooth muscle action affects cardiac output. 2) Smooth muscle is primarily found in the lining of the heart and blood vessels. 3) The smooth muscle which affects cardiac output the greatest is found in the lining of the heart. 4) Smooth muscle which is found in the lining of blood vessels also affects cardiac output but to a lesser extent than cardiac smooth muscle. 5) Cardiac output is the amount of blood that leaves the left ventricle of the heart in a certain amount of time. 6) The cardiac output of humans is normally about five litres per minute. 7) Besides the effect of smooth muscle upon cardiac output there are other facts which can also vary the rate of cardiac output. 8) The cardiac cycle consists of four phases. 9) The action of smooth muscle on the physical activity of smooth muscle affects all four phases. 10) However, the phase of the cardiac cycle in which the action of smooth muscle affects the most is during the early portion of the systolic phase. 11) That early portion of the systolic phase is known as the isovolumetric contraction period. 12) During this period, the ventricles of the heart are filled with a certain amount of blood.
APPENDIX C

Analysis 8

<table>
<thead>
<tr>
<th>No. of types</th>
<th>No. of predications</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. lead-in          Smooth muscle action affects cardiac output.

2. 1 1            a. Type 1 Smooth muscle is primarily found in the...

3. 2 2            a. Type 3 Smooth muscle COMPARE other smooth muscle
                  ("the greatest")
b. Type 1 Smooth muscle is found in the lining of the...

4. 3 5            a. Type 1 Smooth muscle is found in the lining of...
b. Type 3 Sentence 4a COMPARE other smooth muscle ("also")
c. Type 2 Sentence 4a effects cardiac output
d. Type 3 Sentence 4c COMPARE Sentence 4e ("to a lesser extent")
e. Type 2 Cardiac smooth muscle effects cardiac output

5. 1 1            a. Type 1 Cardiac output is the amount of blood that
                  leaves the left ventricle of the heart

6. 1 1            a. Type 1 The cardiac output of humans is normally...

7. 2 3            a. Type 3 Factors COMPARE the effect of smooth muscle...
b. Type 3 Factor CAUSE Sentence 7c
c. Type 2 The rate of cardiac output varies

8. 1 1            a. Type 1 The cardiac cycle consists of four phases

9. 1 1            a. Type 3 All four phases affected by the action of
                  smooth muscle on the physical activity of
                  smooth muscle (?)

Number of sentences with relational information: 4 out 8, or 50%.
Number of relational predications per sentence: .75.
Average number of predications per sentence: 1.87.
Passage 9

1) The digestive system has immune system components. 2) These immune system components are found in the walls of the alimentary canal. 3) The walls of the digestive system consist of four distinct layers. 4) The four layers are mucosa, submucosa, muscularis externa, and adventitia or serosa. 5) Primarily, the immune system components are found only in the mucosa, and submucosa layers.

6) The mucosa layer of the digestive tract is comprised of three layers. 7) The mucosa layer is the innermost layer of the four distinct layers. 8) It is the layer that is closest to the lumen of the digestive tract. 9) The three layers which constitute the mucosa layer are, epithelia cell layer (innermost), lamina propria (middle), and muscularis mucosae (outermost, adjacent to the submucosa).
APPENDIX C

Analysis 9

1. lead-in

2. 1 1  a. Type 1 These immune system components are found in...

3. 1 1  a. Type 1 The walls of the digestive system consist...

4. 1 1  a. Type 1 The four layers are mucosa, submucosa...

5. 1 1  a. Type 1 Primarily, the immune system components are...

6. 1 1  a. Type 1 The mucosa layer of the digestive tract is...

7. 1 1  a. Type 1 The mucosa layer is the innermost layer of...

8. 2 2  a. Type 1 The layer is close to the lumen
        b. Type 3 It COMPARE other layers

9. 1 2  a. Type 1 The three layers are epithelia cell layer,...
        b. Type 1 The layers constitute the mucosa layer

Number of sentences with relational information: 1 out of 8, or 12%.

Number of relational predications per sentence: .12.

Average number of predications per sentence: 1.25.
APPENDIX C

Passage/Analysis 10:

Rudy, April 27 (later sample)

Passage 10

1) Several body systems are involved in maintaining salt and water balance. 2) These body systems are in turn regulated by the endocrine and nervous systems. 3) The endocrine components which is involved in maintaining salt and water balance is the adrenal glands, and the neuroendocrine component is the hypothalamus. 4) Both components under the response to sensory stimuli, will release a specific hormone and neurohormone that will take its effects primarily on the kidney. 5) The kidney itself has a system for maintaining the osmolarity of body fluid.

6) Sensory receptors that are located in the walls of the internal carotid blood vessel and also the left atrium are able to monitor the serum tonicity of the blood. 7) During an accident where there is huge amounts of blood loss, the blood pressure will decrease.
APPENDIX C

Analysis 10

1. lead-in
   Several body systems are involved in maintain...

2. 2 2
   a. Type 2 These systems are regulated by the endocrine...

3A. 2 2
   *a. Type 2 The endocrine components is involved in...
   b. Type 3 It IDENTIFY the adrenal glands

3B. 2 2
   a. Type 2 The neuroendocrine components is involved in
   b. Type 3 It IDENTIFY the hypothalamus

4. 2 5
   a. Type 3 Components COMPARE ("both")
   b. Type 2 Components respond to sensory stimuli
   c. Type 3 Sentence 4b CAUSE Sentence 4e
   d. Type 2 Components release a specific hormone and...
   e. Type 2 This will take its effect primarily on the

5. 3 3
   a. Type 3 The kidney COMPARE other systems ("itself")
   b. Type 1 The kidney has a system
   c. Type 2 The system maintains the osmolarity of body

6. 3 3
   a. Type 3 Sentences 6b,c SPECIFY Sentence 5
   b. Type 2 Sensory receptors monitor the serum tonicity...
   c. Type 1 Sensory receptors are located in the walls of...

7. 2 3
   a. Type 3 Sentence 7b CAUSE Sentence 7c
   b. Type 2 Huge amounts of blood are lost in an accident
   c. Type 2 The blood pressure decreases

Number of sentences with relational information: 7 out of 7, or 100%.
Number of relational predications per sentence: 1.14.
Average number of predications per sentence: 2.86.

*Independent clauses are counted as sentences.
APPENDIX C 

Passage/Analysis 11:

Tomas, March 2 (early sample)

Passage 11

1) The digestive system has immune system components. 2) It is the immune system of the digestive system which allows the organism to combat foreign molecules that happen to enter the body. 3) These foreign molecules are taken care of by the macrophages, lymphocytes and other phagocytic cells of the body.

4) Before we discuss the immune system of the digestive system, it is only proper to recognize that the digestive system has four tissue layers. 5) It is within the tissue layers that you would be able to find the immune system components.

6) The lumen of the digestive system is the cavity where food is digested and later absorbed into the cells. 7) The first layer of tissues surrounding the lumen is called the mucosa. 7) It is here in the mucosa where you find the immune system of the digestive system.

9) The mucosa is lined with epithelium. 10) The epithelium is usually classified as simple columnar epithelium. 11) Internal from the epithelium you will expect to find the lamina propria.
The digestive system has immune system components.

- Type 3 The immune system causes the body to combat foreign molecules.
- Type 2 The molecules enter the body.

- Type 2 The macrophages, etc. of the body take care.
- Type 3 The macrophages, etc. are phagocytic cells.

- Type 3 The immune system of the digestive system has four tissue layers.

- Type 1 The lumen of the digestive system is the cavity.
- Type 2 Food is digested and later absorbed.

- Type 1 The mucosa is lined with epithelium.
- Type 1 The epithelium is usually classified as simple.
- Type 1 The lamina propria is internal from the...
APPENDIX C  

Passage/Analysis 12: 

Tomas, April 27 (later sample)

Passage 12

1) The retention of excess salt and water in the extracellular spaces is like drowning the cells. 2) To avoid such metabolic accident, the body removes these two substances to the outside environment so that proper water and salt level could be present around the cells. 3) A high concentration of salt around the cells will tend to create a salt gradient, whereby the sodium or chloride ions will be forced by passive diffusion to enter the cell resulting in a condition called edema. 4) This the body has to regulate so that its cellular activities, like the making of adenosine triphosphate and so forth, will not be hindered.
APPENDIX C

Analysis 12

1. 2 3
   a. Type 2 Excess salt and water is retained in the...
   b. Type 2 The cells are drowned
   c. Type 3 Sentence 1a COMPARE Sentence 1b

2. 3 4
   a. Type 2 The body removes the two substances to the
   b. Type 1 (The body has no) metabolic accident
   c. Type 3 Sentence 2a CAUSE Sentence 2b, 2d
   d. Type 1 The proper salt and water balance can be...

3. 3 5
   a. Type 2 A high concentration of salt around the cells...
   b. Type 3 Sentence 3a CAUSE Sentence 3c
   c. Type 2 Sodium or chloride ions forced by passive...
   d. Type 3 Sentence 3c CAUSE Sentence 3e
   e. Type 1 (There is a) condition called edema

4. 2 5
   a. Type 2 The body regulates this
   b. Type 3 Sentence 4a CAUSE Sentence 4c
   c. Type 2 Cellular activities will not be hindered
   d. Type 2 ATP is made
   e. Type 3 Sentence 4d SPECIFY NP in Sentence 4c

Number of sentences with relational information: 4 out of 4, or 100%.

Number of relational predications per sentence: 1.50.

Average number of predications per sentence: 4.25.
APPENDIX C

Passage/Analysis 13:
Tua, March 2 (early sample)

Passage 13

1) The digestive system has immune systems components. 2) These components are nonspecific and specific immune responses. 3) The nonspecific immune responses includes the inflammatory response and the interference. 4) The inflammatory response usually refers to a disruption of the metabolism when any microbes enters the body. 5) This disruption of the metabolism by microbes lead to tissue damaging, which then activates the most cells to release histamine as well as altering the vascular surface of the blood vessels. 6) As a result of histamine being released, it increases the vasodilation and permeability to food substances or proteins. 7) Also, at the same time, the resistance of the blood vessels has decreased. 8) Therefore, it enhances the flow of blood to various parts of the body much more efficiently.
APPENDIX C

Analysis 13

The digestive system has immune systems composed...

<table>
<thead>
<tr>
<th>Sentence</th>
<th>Type</th>
<th>Specific/General</th>
<th>Cause</th>
<th>TIME</th>
<th>Compare</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td>Type 3</td>
<td>Sentence 2b SPECIFY Sentence 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>Type 1</td>
<td>These components are nonspecific and specific...</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td>Type 3</td>
<td>Sentence 3b SPECIFY Sentence 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>Type 1</td>
<td>The nonspecific immune responses includes the...</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>3</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td>Type 3</td>
<td>Sentence 4b SPECIFY Sentence 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>Type 1</td>
<td>The inflammatory response usually refers to Sentences 4c,d,e</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td>Type 2</td>
<td>Microbes enter the body</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d.</td>
<td>Type 2</td>
<td>The metabolism is disrupted</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e.</td>
<td>Type 3</td>
<td>Sentence 4c CAUSE Sentence 4d</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>2</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td>Type 3</td>
<td>Sentence 4d CAUSE Sentence 5b</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>Type 2</td>
<td>Tissues are damaged</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td>Type 3</td>
<td>Sentence 5b CAUSE Sentences 5d,e</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d.</td>
<td>Type 2</td>
<td>The cells release histamine</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e.</td>
<td>Type 2</td>
<td>The vascular surface of the blood vessels...</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>2</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td>Type 2</td>
<td>Histamine is released</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>Type 3</td>
<td>Sentence 5a CAUSE Sentence 5c,d</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td>Type 2</td>
<td>Vasodilation increases</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d.</td>
<td>Type 2</td>
<td>Permeability to food substances or proteins...</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td>Type 3</td>
<td>Sentence 7b at TIME</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>Type 2</td>
<td>The resistance of the blood vessels has dec...</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td>Type 3</td>
<td>Sentence 7b CAUSE Sentence 8b,c</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>Type 2</td>
<td>The blood flows</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td>Type 3</td>
<td>Sentence 8b COMPARE (other blood flow)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Number of sentences with relational information: 7 out of 7, 100%.

Number of relational predications per sentence: 1.43.

Average number of predications per sentence: 3.28.
Passage 14

1) Several body systems are involved in maintaining salt and water balance. 2) One of the most important system is the urinary system. 3) The urinary systems primarily control the balancing of the salt and water processes. 4) The maintaining of these processes is done in three ways. 5) The first one is the reabsorption of sodium. 6) This is an active process, which involves a carrier (unclear) and it requires an energy supply and it can occur against the electrochemical gradient. 7) The second process is the reabsorption of chloride by means of passive diffusion. 8) This depends upon the active reabsorption of sodium.
### APPENDIX C

**Analysis 14**

<table>
<thead>
<tr>
<th>No. of types</th>
<th>No. of predications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. lead-in</td>
<td>Several body systems are involved in maintain...</td>
</tr>
</tbody>
</table>
| 2. 2 2       | a. Type 1 One important system is the urinary system  
               b. Type 3 (It) COMPARE (other systems) |
| 3. 2 2       | a. Type 2 The urinary system primarily controls the...  
               b. Type 3 Sentence 3a SPECIFY Sentence 2 |
| 4. 2 2       | a. Type 2 The maintaining of these processes is done in...  
               b. Type 3 Sentence 4 SPECIFY Sentence 3. |
| 5. 2 2       | a. Type 2 Sodium is reabsorbed  
               b. Type 3 Sentence 5 SPECIFY Sentence 4 |
| 6A. 2 3      | *a. Type 1 This is an active process  
               b. Type 2 (It) involves a carrier (unclear)  
               c. Type 3 Sentence 6A SPECIFY Sentence 5 |
| 6B. 2 2      | a. Type 1 It requires an energy supply  
               b. Type 3 Sentence 6B SPECIFY Sentence 5 |
| 6C. 2 2      | a. Type 2 It can occur against the electrochemical...  
               b. Type 3 Sentence 6C SPECIFY Sentence 5 |
| 7. 2 4       | a. Type 2 Chloride is reabsorbed  
               b. Type 3 Sentence 7c CAUSE Sentence 7Aa  
               c. Type 2 (Chloride) diffuses passively  
               d. Type 3 Sentence 7A SPECIFY Sentence 4 |
| 8. 2 2       | a. Type 3 Sentence 8b CAUSE Sentence 7  
               b. Type 2 Sodium is reabsorbed actively |

Number of sentences with relational predications: 7 out of 7, or 100%.

Number of relational predications per sentence: 1.43.

Average number of predications per sentence: 3.00.

*Independent clauses are counted as sentences.
Passage 15

1) Several body systems are involved in maintaining salt and water balance. 2) Water and salt have to be balanced so that the systems as well as the entire body can function properly. 3) The body stores its water and salt. 4) These two can be produced by the food that we eat and by other processes going on in the body. 5) The food that we eat of course go through several processes in the digestive system. 6) The glands' secretions are mostly water. 7) They are secreted into the digestive tract to mix with the food or to balance out the fluid in this tract. 8) The intestines are the sites for minerals and H₂O absorption. 9) These minerals and water get into the blood where they are influenced by hormones.
Several body systems are involved in maintaining water and salt balance. The systems as well as the entire body can store water and salt. We eat food, and other processes go on in the body. The glands secrete the food that we eat of course go through the digestive tract. Minerals and water are absorbed in the intestines. These minerals and water get into the blood and are influenced by hormones.
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