

**Academic Text Features and Reading
In English as a Second Language**

**Richard P. Durán, Susan R. Goldman, and Michael Smith
University of California, Santa Barbara**

**Technical Report
August, 1989**

SOIC
ELECTE
SEP 29 1989
E D

This project was supported by the Office of Naval Research Cognitive Science Program, under contract N00014-85-K-0562, authorization number NR442c015. The contributions to this work of Anne Fay are gratefully acknowledged. Reproduction in whole or part is permitted for any purpose of the United States Government. Approved for public release; distribution unlimited.

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION Unclassified			1b. RESTRICTIVE MARKINGS	
2a. SECURITY CLASSIFICATION AUTHORITY			3. DISTRIBUTION / AVAILABILITY OF REPORT Approved for public release; distribution unlimited.	
2b. DECLASSIFICATION / DOWNGRADING SCHEDULE				
4. PERFORMING ORGANIZATION REPORT NUMBER(S)			5. MONITORING ORGANIZATION REPORT NUMBER(S)	
6a. NAME OF PERFORMING ORGANIZATION University of California Santa Barbara		6b. OFFICE SYMBOL (If applicable)	7a. NAME OF MONITORING ORGANIZATION Cognitive Science Program Office of Naval Research (Code 1142CS)	
6c. ADDRESS (City, State, and ZIP Code) Department of Education University of California Santa Barbara, CA 93106			7b. ADDRESS (City, State, and ZIP Code) 800 North Quincy Street Arlington, VA 22217-5000	
8a. NAME OF FUNDING / SPONSORING ORGANIZATION		8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER N00014-85-K0562	
8c. ADDRESS (City, State, and ZIP Code)			10. SOURCE OF FUNDING NUMBERS	
			PROGRAM ELEMENT NO. 61153N	PROJECT NO. RR04206
11. TITLE (Include Security Classification) Academic Text Features and Reading in (English as a Second Language)				
12. PERSONAL AUTHOR(S) Richard P. Durán, Susan R. Goldman, and Michaela Smith				
13a. TYPE OF REPORT Technical	13b. TIME COVERED FROM 1985 TO 1988	14. DATE OF REPORT (Year, Month, Day) August 29, 1989	15. PAGE COUNT 29	
16. SUPPLEMENTARY NOTATION				
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number) Text Features, Reading, ESL	
FIELD	GROUP	SUB-GROUP		
05	10			
19. ABSTRACT (Continue on reverse if necessary and identify by block number) Several general text characteristics can have significant impact on reasoning and comprehension. In our efforts to examine the strategies ESL students' employ when learning from text, it became necessary to carefully examine such text characteristics. We first review the literature on ESL students' study strategies and how they might interact with formatting and linguistic conventions in text. Three classes of discourse-level phenomena are then described and illustrated with examples from typical college texts: topic development and background knowledge, subordination, and logical connectors. We suggest several ways in which these potentially impact ESL reading strategies. Finally, directions for research and some preliminary empirical findings from work conducted with ESL students are presented.				
20. DISTRIBUTION / AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS			21. ABSTRACT SECURITY CLASSIFICATION Unclassified	
22a. NAME OF RESPONSIBLE INDIVIDUAL Dr. Susan Chipman			22b. TELEPHONE (Include Area Code) 202-696-4318	22c. OFFICE SYMBOL ONR1142CS

Academic Text Features and Reading in English as a Second Language

Reading of academic text materials for problem solving purposes involves knowledge and skills which are complex. The development of these skills among adult learners of English as a Second Language (ESL) is interesting on both practical and theoretical grounds. In this paper we discuss some characteristics of texts and naturally occurring academic passages that influence a reader's ability to orient to a text and to extract meaning from passages for the purpose of answering questions, creating summaries, or performing other learning tasks. The text analysis work described here is part of a program of empirical research investigating reasoning and reading comprehension processes among college level, second language learners in fields such as introductory oceanography, psychology, and other academic areas. This paper arises out of issues we had to consider in attempting to investigate the reasoning and text comprehension of ESL students. Our purpose in the paper is to identify some important kinds of text features that might help steer ESL and non-ESL readers through the distribution and organization of ideas in a text. Accordingly, we are here most interested in text features that serve high-level semantic functions. That is, we are interested in units of language and other printed cues that convey key concepts, and in addition, complete ideas or thoughts at the sentence-level and beyond.

Our approach to text description is informed by three theoretical perspectives that are complementary. First, congruent

with cognitive research on reading comprehension and metacognition, we hypothesize that a student's reading performance and reading strategies for the purpose of answering questions need to be understood as an interaction among learner, task, and text characteristics (Goldman & Durán, 1988; Brown, Armbruster, and Baker, 1986). Central to this perspective is the idea that a good reader monitors his or her comprehension and that when comprehension difficulties arise, the reader enacts reading strategies to compensate for these difficulties. Second, in agreement with emerging research on assessment of second language proficiency, we find it helpful to consider the full range of language recognition and comprehension skills needed by readers (Canale and Swain, 1980; Durán, Enright & Rock, 1985). These skills include an ability to recognize and understand how meaning is cued by graphemic codes (e.g. punctuation,), lexical and grammatical structures, and by discourse features signalling introduction, organization, and development of information. We also consider the skill of good readers to recognize and understand additional semantic cueing devices of a text which augment or go beyond the literal language of a text. In this light, we consider, e.g. a reader's ability to recognize the purpose and function of tables, graphs, text boxes, margin notes, etc. and the information that they convey about an academic subject.

A third theoretical view we find informative stems from anthropological and ethnographic studies of literacy. Ethnographic studies (e.g. Heath, 1983 and Scribner & Cole, 1981) indicate that people's *in situ* reading of a text involves strategic behaviors which are highly context-sensitive to text features and to the social,

everyday demands of tasks involving reading. Thus, in portions of our research we are interested in learning how an individual actually interacts with a text as they perform or prepare for academic tasks. We are especially interested in discovering strategic behaviors that embody a parsimonious but powerful set of cognitive operations accounting for reading behavior during problem-solving tasks such as answering questions (Goldman and Durán, 1988).

We believe that an approach building on the areas cited can contribute in an important fashion to a more realistic and comprehensive understanding of what readers do as they actually perform academic learning tasks using textual materials. The approach appears especially useful for studying second language learners' reading skill development because it can prove sensitive to a wide range of compensatory strategies applied by readers as they encounter comprehension problems. We note in passing, however, that our approach applies just as much to native readers of a language as to second language learners.

We will discuss several general text characteristics which we believe can have a significant impact on second language students' comprehension and inferential operations drawing on the perspectives cited above. First, we will discuss ESL students' strategies for studying texts in everyday activities. We then go on to discuss text organization, formatting and language characteristics of texts.

ESL Students' Study Strategies

ESL readers need to judge how their overall capacity to comprehend English texts and prior knowledge of a content or skill area affect their strategies for studying from a text. Evidence exists that

students from non-English backgrounds are sensitive to the impact of limited verbal skills on their ability to perform academically. Duran, Enright, and Rock (1985), for example, found that Hispanic college candidates' self-judgments of ability to read, write, orally comprehend, and speak English were significantly correlated with students' SAT verbal test scores. However, the impact of English proficiency on the reading strategies employed by adult ESL college students has not been investigated intensively. Anecdotal evidence suggests that ESL students rely on a number of compensatory reading strategies. Commonly cited strategies include reading assisted by an English dictionary, asking peers for help with English vocabulary terms, rereading materials several times, and deliberate slow reading to insure through comprehension.

We lack research, however, on how specific compensatory reading strategies of ESL students interact with the characteristics of texts themselves. Anderson and Armbruster (1985), while concerned with monolingual students, offer informative suggestions that can be extended to breach this gap. They outline characteristics of "good" as opposed to "poor" texts that can help learners acquire knowledge. According to Anderson and Armbruster good texts have the advantages outlined below:

1. Criteria for studying will be clearer to students because
 - a. The titles, headings and topic sentences help the student identify the questions that the text is answering.
2. Focusing attention will be easier because

- b. Each idea unit in the regular text is important, in that it contributes to an answer and/or a question.
 - c. The idea units that have a high probability of being nonessential are clearly marked by being in a box.
 - d. The hierarchical structure of the text and high degree of unity make it easy and efficient for students to locate a specific text unit. Entire chunks of irrelevant text can be easily identified and skipped over.
- 3.
- e. The high degree of coherence, structure, and unity will enable the students to select and rapidly engage in a variety of activities to promote encoding such as outlining, mapping, underlining, and notetaking. Even the more time-consuming activities proceed very smoothly when using text with these characteristics.
 - f. The hierarchical structure of the text encourages students to use a top-down, higher-level perspective when reading and organizing ideas from the text. This perspective is contrasted with a bottom-up one in which the students are not sure where the author is going, and must put the puzzle together in an inefficient, piecemeal fashion (p. 175).

The qualities of a good academic text suggested by Anderson and Armbruster allude to some of the learning demands that may be faced by students in learning tasks. For example, these demands may include understanding implicit or explicit questions answered by a text, and comprehending the immediate usefulness and function of individual idea units as they occur. They also cite metacognitive learning

strategies used by students as they interact with a text, e.g., outlining, mapping, and notetaking, and the recognition and acquisition of high-level organizers for text information.

Text characteristics and text processing strategies such as those cited by Anderson and Armbruster are embedded within specific learning activities and they point to the importance of an ESL student's ability to interpret the nature of a learning activity effectively. While there is only a limited empirical research base on the strategies ESL students use in reading a text given its characteristics, further research can be motivated by discussing some of the most salient characteristics that ought to affect reading.

These characteristics include the organizational formatting of a text, the use of printing and type-font conventions as signalling devices for meaning, and the use of discourse and other linguistic conventions to encode text information. The range and variety of signaling devices occurring in texts is evident in the following list developed by Lorch (in press).

Titles

Headings and Sub-headings

Repetition of content, including

Exact repetition of a statement for emphasis

Certain types of preview statements

Certain types of summary statements

Function indicators, including:

Pointer words (e.g., "thus")

Pointer phrases (e.g., "in summary")

Acquisition For	
NAME	☒
DATE	☒
UN	☐
Substitution	☐
By	
Distribution/	
Acquisition Codes	
Acquisition for	
Dist	Special

A-1

Pointer sentences (e.g., "Let me summarize what has been said")

Relevance indicators, including:

Pointer statements or phrases emphasizing particular content (e.g., "Let me stress that...")

Enumeration devices (e.g., numbering points in an argument)

Typographical cues, including:

Underlining

Change of appearance in print (e.g., boldface, color)

Distinguishing content spatially (e.g., indentation, centering)

Lorch also summarizes the findings of psychological studies of the effects of these signaling devices on reading and meaning processes. The general findings of research indicate that memory of and attention to text information is positively affected by signaling devices among monolingual subjects. Goldman (1988) has reported that ESL college students are also subject to the positive effects of signals. As well, ESL students are sensitive to the usage conditions of logical relation indicators, i.e. connectors. (Goldman & Murray, 1989; MacLean & d'Anglejan, 1986).

We now turn to a more specific discussion of these and other signalling devices that ought to be expected to affect the reading processes of ESL students.

Text Organization and Formats

Textbooks have parts and follow formatting and layout conventions that aid readers in getting at text meaning (Duffy and

Waller, 1985). While we are readily aware that the principal ideas in a text are presented in language, we are also aware of additional ways in which meaning is conveyed in a text. For example, we notice that a text can have parts such as a title page, table of contents, preface, introduction, chapters, glossaries, appendices, and an index. These parts of a text serve as organizers for the overall meaning available in a text and good readers would be expected to recognize these formats and their functions. The table of contents, for example, provides a conveniently accessible outline of the overall organization of a text into chapters, sections and subsections, and the pages corresponding to these text segments. The importance of the table of contents as an organizer of text information and, as well, as an organizer of a field of knowledge is underestimated by the novice studying a text for the first time. The apprentice learner is unable to grasp the significance of the table of contents as a high-level framework depicting organization of knowledge in a field compiled by an expert teaching this knowledge. But, perhaps, this makes sense. The practical function of a table of contents is to assist the learner in locating pages in a text corresponding to various sections of information. Some text formats are of special importance to ESL readers. For example, we know that ESL students are more likely to encounter vocabulary recognition difficulties than other students (Durán et al., 1985), hence, knowing how to locate and use an index and glossary for such students could be extremely helpful.

Within text chapters there are other forms of text organization that can guide readers' access to meaning. Such organizers include, e.g., sections and subsections within a chapter, sideheaders, text boxes,

graphs, tables, and figures. Sections and subsections of chapters are structured around the main topics to be covered in a chapter.

It is common--but not universal--that students' reading and classroom assignments focus on material found within specific sections and subsections of a text chapter. It is at this level of text organization that we become most interested in the cognitive and linguistic strategies applied by students as they work academic assignments such as answering questions. The notion that chapters, sections and subsections of a text are organized around key material to be learned would appear equally salient to students regardless of their language background. Ability to find portions of text pertinent to academic assignments, however, may differ for ESL and native-English speaking students and may interact with a student's prior knowledge of subject matter when active searching for text information is required in order to answer questions (Goldman and Duran, 1988). According to the model developed by Goldman & Durán (1988), the question answering task involves several processes. Students must interpret the linguistic statement of a question in terms of a question topic; they must identify relevant information provided by the text as a function of knowledge they already possess; further, they must identify what is the nature of the unknown information required in a response to a question.

Text boxes are typically used to present supplementary information that cannot be adequately covered in the main body of a chapter section. Graphs, tables, and figures and their labels serve a number of functions that are often central, rather than supplementary to text comprehension. Perceptually they serve as visual aids to

comprehension and they may illustrate or expand upon information conveyed linguistically in the main body of a text. In technical texts these aids are often used to visually exemplify the operations of principles or to display relationships of a quantitative nature among variables in some system under discussion in a text section. Labels accompanying these learning adjuncts are themselves informative. Students need to recognize the ways in which labels summarize the key concepts and relationships depicted in these learning adjuncts.

Type-Font Conventions

Occurrence of the foregoing formats and structures in a text is accompanied by variations in type font conventions that provide information. Each academic text establishes its own conventions for the way in which type is manipulated to encode information. Examples of conventions might include use of italics, quotation marks, or bold-face type when new terms or concepts are first introduced and defined. Still another set of conventions is the use of larger size, bold face type and capital letters in the statement of chapter titles, section headers, and sideheaders. Recognition of these graphemic conventions to assist access to text information appears to rely on perceptual recognition strategies that are distinguishable from strategies in the decoding of natural language. Type-font conventions serve a different semiotic function. They signal through physical appearance information about text organization that can help a learner in orienting to text meaning and value to learning. We know little of how these conventions affect learning, though much knowledge about how to design and manipulate typing conventions is exercised in the production of textbooks (Duffy and Waller, 1985).

The ability of ESL as opposed to non-ESL readers to recognize the functions of type-font conventions is more related to the academic, cultural experiences of learners than to their ability to understand a second language. And the same can be said for the ability to understand other formatting conventions for organizing text information. Nonetheless, these features of a text must be considered in developing an adequate understanding of ESL students' reading strategies. Because of cultural and social experience differences, there is always the possibility that ESL readers may not be familiar with the utility of these conventions as aids to learning.

It is interesting to note that the semantic significance of text formatting conventions and type font conventions to text understanding is not typically considered worthy of systematic attention in ESL courses. Indeed it was not until the early 1970's that such concerns were considered relevant for a comprehensive description of language processing skills. In recent years concerns for skill in processing graphemic conventions in general has emerged in descriptive frameworks for describing the communicative competence skills that ESL students must acquire (Canale & Swain, 1980).

We next consider some of the discourse and natural language characteristics of texts that are important for ESL readers to recognize.

Discourse and Linguistic Conventions

There is no unified and comprehensive theory for the structure of English discourse, or the structure of discourse in any language, for that matter. There is a trend in recent years, however, to focus attention on the centrality of the communicative functions served by

discourse and for how these functions are signalled in natural language. Brown and Yule (1983), for example, adopt this perspective and suggest two major functions: transactional and interactional. The transactional function best depicts the function of textbook language, namely the expression and transmission of content knowledge. The interactional function of discourse, on the other hand, has as its primary purpose the negotiation of interpersonal social relationships among interlocutors.

Transactional discourse is characterized by assumptions or maxims about the intentions of a writer relative to a reader, and in this sense, it has a social kernel, though it is not intended to dynamically regulate on-going social relations among active interlocutors. We do not have a clear and unambiguous model for these assumptions and conventions in the case of academic texts, but they appear to include certain beliefs. A first assumption is that text discourse is topic-centered and that the text of a chapter, its sections and subsections are intended to elaborate knowledge about a topic. Two additional assumptions are the belief on the part of the reader that texts present veridical information, and the belief that as text material is presented it consists of coherent and logically consistent elaborations of knowledge about a topic.

The extent to which these assumptions vary across languages and how different languages realize discourse conventions is the subject of study of the field known as contrastive linguistics (Kaplan 1966). While we are unable to explore this area here, it is worthwhile noting that there is evidence suggesting that there are culturally-based tendencies and preferences in the way expository discourse can be

organized. This has implications for better understanding the reading strategies of ESL students. Research is needed on how the language background of such students affects students' ability to sense the discourse structure of English-language texts.

Given the foregoing caveat, we will proceed to mention three classes of English discourse-level phenomena that need to be recognized by ESL readers and that merit further research regarding their affects on comprehension processes. These phenomena include: recognition of topic development and background knowledge, subordination, and the occurrence and use of logical connectors. All of these phenomena are interrelated and occur in discourse. Nonetheless, each merits separate attention in light of the academic reading comprehension skills that ESL students are expected to develop.

Topic Development and Background Knowledge

Cognitive psychologists have used the term "macrostructure of a text" to refer to the underlying semantic representation of the main ideas or topics and the way they are globally elaborated by a text (Kintsch & van Dijk, 1978). The macrostructure of a text is distinguished from its microstructure. The latter term refers to the way in which each separate idea in a text is sequentially connected to preceding ideas.

Academic texts in English at the college level are characterized, typically, by a macrostructure resembling a linear outline. A chapter focuses on a central topic and the separate sections and subsections of the chapter go on to develop information about the topic. This development proceeds sequentially and in a cumulative manner. Comprehension of a given section or subsection of text presupposes

comprehension of previously occurring sections and subsections, and often previous chapters of text.

The fact that academic texts introduce and elaborate topics in a linear-outline manner does not imply that the underlying knowledge acquired by the learner is structured in memory in this manner. Cognitive psychologists investigating discourse comprehension, for example, suppose that memory for text is better represented as a network of interconnected propositions derived from a text and stored in long-term memory (e.g., Beaugrand, 1980; Kintsch & van Dijk, 1978; Rumelhart, 1977).

The ultimate goal of learning from a textbook is to assist the reader in acquiring a mental representation in long-term memory for the knowledge conveyed by a text. The relevant background knowledge stored in long-term memory that a learner brings to the task of reading a text and to completion of text assignments is critical. In essence, the learner must activate this knowledge and use it in the act of comprehension to build a representation of new information conveyed by a text. Further, the representation that is built must be made useful by the development of procedural knowledge aiding the learner in applying new knowledge toward the solution of problems and assignments drawing on this knowledge.

One of the most important issues in research on ESL students' academic reading skills concerns the extent to which their background knowledge--especially previous study of an academic topic--affects their reading strategies and sensitivity to topic development in a text. Hypothetically, an ESL reader with a strong command of a topic will be able to recognize the macrostructure of text and will be able to

activate corresponding content knowledge accordingly. The processing of text by such a reader in light of his or her limited English proficiency may be very different from the processing of text by another reader with limited English proficiency, but with a lack of familiarity with an academic topic. The ESL student with a strong topic familiarity should be able to process text better in a top-down manner than the ESL student with a weak topic familiarity. Both types of students will be able to process text in a bottom-up manner subject to their command of English, but the student with a weak topic familiarity may need to expend more effort and have more difficulty integrating text information into an underlying knowledge representation maintained in long-term memory (Goldman & Durán, 1988).

There are certain language mechanisms that can make more apparent the microstructure, and in some cases the macrostructure. Lorch (in press) referred to these as function indicators; Meyers' (1975) rhetorical devices are function indicators. Furthermore, the sentence-level organization of information carries meaning regarding the meaning relations among the informational elements. That is, one idea may be subordinated to a second. The subordination per se communicates information about appropriate topic-elaboration. Subordination and logical connectors are discussed in the next section.

Subordination

Subordination relates to how language is used to introduce and develop topics and how topics are connected across stretches of text. This issue pertains to the semantic microstructure of a text and to how sentence and clause units are structured and connected syntactically to

express the microstructure. As a reader encounters text sequentially, he or she must recognize the topic under discussion and must recognize elaborations of the topic. In this process readers must distinguish previously given or foreground information from new information and the relationships between the two (Perfetti & Goldman, 1974).

Discourse level text involves multiple sentences. Individual sentences may involve a simple clause consisting minimally of a subject and a main verb. Complex sentences consist of a main clause and accompanying dependent clauses. The latter are not typically independent sentences. Clauses and sentences have either a coordinate or subordinate relationship to each other. Coordinate clauses and sentences are of equal semantic rank in that they express independent information about a topic. As an example of two coordinate clauses, one an independent clause and the other a dependent clause, consider:

*This is due to the abundance of surface water [indep. cl.]
and its remarkable thermal properties [dep. cl.].*

These two clauses have a coordinate relationship to each other because they present independent information about a topic: mildness of the earth's climate.

Two clauses have a superordinate-subordinate relation when one clause, the superordinate clause can stand alone as complete sentence, but is accompanied by another dependent clause to form a compound sentence. The dependent clause cannot stand alone as a sentence and it provides semantic information about a topic that can be understood only in relation to the semantic information provided in the

superordinate clause. Subordinate clauses often take the form of an adverbial clause connected semantically to a superordinate clause by means of a logical connector. Consider for example the compound sentence:

Although roughly equal in thickness, the oceans are 90 times more massive than the atmosphere.

In this example, the adverbial clause "*Although roughly equal in thickness*" has a subordinate relationship to the main independent clause which follows. That is, it does not make sense on its own, but must be interpreted as semantically dependent on another clause. The adverbial clause references the specific topic of the sentence (equality in thickness of the oceans and atmosphere) and the subsequent independent clause contributes new information about the topic. The logical connector "*although*" at the outset of the adverbial clause signals that a semantic contrast or oppositional relationship is being presented between two ideas.

To understand an academic text, readers must recognize the occurrence of subordinate relationships among clauses. Further, readers must be able to recognize adverbial clauses and the use of logical connectors to establish explicit semantic relationships among the ideas expressed in clauses. The ability to comprehend written language in this manner requires a high-level of English language proficiency. It requires extensive knowledge of English sentence-level syntax and also a knowledge of how the syntactic structure of English operates to signal semantic relationships across clausal units. It also

requires extensive knowledge of how logical connectors establish relationships among ideas expressed by clauses.

Before turning to a more detailed discussion of functions of logical connectors, it should be noted in passing that subordination can encompass additional purposes in sentence syntax, co-occurring with their functions to mark given-new, topic-comment, and logical functions at the discourse level (Greenbaum, 1989). For example, subordinate clauses may operate as noun phrases as in

Saving energy will help our balance of payments

or as modifiers and complement clauses, as in

Drugs that are used in chemotherapy change a patient's healthy cells as well.

To comprehend a text, students must recognize the occurrence of these subordination functions, noting their within sentence syntactic function, as well as their function in developing a text topic and in showing logical relations to other text information.

Logical Connectors

Logical connectors are words or terms that semantically connect ideas conveyed in separate phrases, clauses, or sentences. As mentioned in the previous section their use is intimately related to the way given and new or topic and comment information are marked in superordinate and subordinate relationships to each other. These functional units of language are an important subclass of cohesive devices in English. Halliday and Hasan (1979), under the rubric of conjunctive cohesion, distinguish four types of transitional expressions: additive, adversative, causal, and temporal.

Additive transitional expressions signal that ideas across clauses add to information about a topic. They are used to signal addition of information, introduction of new information, relationships of similarity, etc. Additive transitional expressions are underlined in the following sentences taken from an oceanography text:

For instance, if air at 25°C were 3.1% water vapor, then the absolute humidity would be 3.1% whereas the relative humidity would be 100%.

If air at 100% relative humidity is cooled, then it becomes super saturated and the excess moisture precipitates.

Furthermore, in spite of our sentiments during the rainy season, the atmosphere holds only a thousandth of a percent of the hydrosphere's water.

Adversative logical connectors signal conflict, contradiction, concession, etc. among ideas. Examples of these connectors are underlined below in sample sentences occurring in the oceanography text.

In spite of its low water content, the atmosphere serves as an important agent in the transfer of water from one reservoir to another.

The ocean loses water to the atmosphere via evaporation, but gains it back through precipitation, run-off from the land, and melting of ice.

Although the required amount of sensible heat does not depend on the initial temperature of the air, the amount of latent heat does.

Causal logical connectors are used to signal cause/effect, reason/result, and similar causal or logically contingent relationships. Examples of these expressions are underlined below.

Due to collisions between molecules, their motions are quite chaotic.

We call air "saturated" if it is holding as much water as it can.

Over the continents, the precipitation exceeds evaporation, and so some of the water must be returned to the oceans via the rivers and underground flow.

Sequential logical connectors are used to signal an explicit chronological or logical order among ideas and expressions of summation of ideas. Below are examples:

In addition to low rates of evaporation, the land has two special talents for coaxing moisture out of the air. First it is higher.

Next, a special talent that the land has to coax water from the air is its large daily and seasonal temperature fluctuations.

As the above example shows, at higher temperature, relatively larger fractions of the added heat can go into evaporating water.

Celce-Murcia and Larsen-Freeman (1983) suggest that ESL students' command of logical connectors is a good indicator of students' syntactic maturity. They discuss the difficulty of ESL students in learning how to use these connectors correctly and in understanding how to properly position connectors at the start of a first clause, between two clauses, and at the end of a second clause.

Directions for Research and Preliminary Findings

The explicit semantic functions of logical connectors make such connectors amenable to research. Goldman and Murray (1989) investigated ESL and native English speaking students' ability to discriminate the appropriateness of alternative connectors in the text. In one of these studies (Goldman & Murray, 1989, Experiment 1) students were presented paragraph-length texts with deleted terms corresponding to a logical connector. Students were asked to pick a correct connector for each slot given four choices representing an additive, adversative, causal, or sequential connector. The results of the study showed that native English speakers were more frequently correct than ESL students, but that both groups of students showed similar patterns of correct and incorrect responses. Students were most often correct when additive or causal connectors were required. Students also showed a propensity when they were wrong to more frequently choose causal alternatives than other incorrect connector types.

However, there was a notable difference between native English and ESL students' confidence ratings in their responses. Native English students were more confident of their adversative and sequential correct choices than of their correct additive and causal choices. ESL students, on the other hand, did not show such differentiation. All students were more confident of correct than of incorrect responses. An accompanying analysis of verbal protocol response justifications suggested that incorrect responses stemmed from failure of students to understand the required semantic relation appropriate to a text slot and failure to select a connector fitting the inferred but incorrect relation from among the alternatives for that slot. In summary, ESL students had greater difficulty in understanding how connectors functioned when embedded in a text than did native English students; further, the ESL students were not as good as the native English in distinguishing when they were correct versus incorrect.

The familiarity of ESL students with English can affect students' sensitivity to the organization of text normally signaled by logical connectors. Goldman (unpublished) found that failure to mark the occurrence of a second point in a text by a sequential connector such as "second" led to poorer recall of the second point by both native English and ESL students. However, the ESL students represented two levels of English proficiency. The ESL students who were least proficient in English were most prone to show the discrepancy between marked and unmarked points.

Results of the studies cited suggest that native English and ESL students may encounter many similar difficulties in processing academic texts, though the weaker English proficiency of ESL students

further undermines their effective comprehension of texts. There is a clear need for further research and it seems likely that such research will contribute to a more precise understanding of the English language and reading comprehension of ESL students.

REFERENCES

- Anderson, T. H., & Armbruster, B. B. (1985). Studying strategies and their implication for textbook design. In T. M. Duffy and R. Waller (Eds.), *Designing usable texts* (pp. 159-177). Orlando, FL: Academic Press.
- Brown, A. L., Armbruster, B.B., & Baker, L. (1986). The role of metacognition in reading and studying. In J. Orasanu, (Ed.), *Reading comprehension: From research to practice* (pp. 49-75). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Brown, G., & Yule, G. (1983). *Discourse analysis*. New York: Cambridge University Press.
- Canale, M., & M. Swain (1980). Theoretical bases of communicative approaches to second language teaching and testing. *Applied Linguistics*, 1, 1-47.
- Duffy, T. M., & Waller, R. (Eds.) (1985). *Designing usable texts*. Orlando, FL: Academic Press.
- Durán, R. (1985). Influences of language skills on bilingual problem solving. In S. F. Chipman, J.W. Segal, and R. Glaser, (Eds.) *Thinking and learning skills: Vol. 2. Research and open questions*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Durán, R., Enright, M., & Rock, D. (1985). *Language factors and Hispanic freshmen's student profile*. New York: College Entrance Examination Board.
- Goldman, S. R. (1988, December). *The role of sequence markers on reading and recall: A comparison of native and nonnative English speakers* (Technical Report). Santa Barbara: University of California.

- Goldman, S. R., & Durán, R. (1988). Answering questions from oceanography texts: Learner, task and text characteristics. *Discourse Processes*, 11, 373-412.
- Goldman, S. R., & Murray, J. (1989, August). *Knowledge of connectors as cohesion devices in text: A comparative study of native English and ESL speakers* (Technical Report). Santa Barbara: University of California.
- Greenbaum, S. (1989). *A college grammar of English*. London: Longman Group, Ltd.
- Halliday, M.A.K. and Hasan, R. (1976). *Cohesion in English*. London: Longman Group, Ltd.
- Heath, S. B. (1983). *Ways with words*. Cambridge: Cambridge University Press.
- Kaplan, A. (1964). *The conduct of inquiry: Methodology for the behavioral sciences*. San Francisco, CA: Chandler.
- Kintsch, W., & Van Dijk, T. A. (1978). Toward a model of text comprehension and production. *Psychological Review* 85, 363-394.
- Lorch, R. (in press). Text signaling devices and their effects on reading and memory processes. *Educational Psychology Review*.
- Perfetti, C.A., & Goldman, S. R. (1974). Thematization and sentence retrieval. *Journal of Verbal Learning and Verbal Behavior*, 13, 70-9.
- Scribner, S., & Cole, M. (1981). *The psychology of literacy*. Cambridge, MA: Harvard University Press.

Dr. Phillip L. Ackerman
University of Minnesota
Department of Psychology
Minneapolis, MN 55455

Dr. Meryl S. Baker
Navy Personnel R & D Center
San Diego, CA 92152-6800

Dr. Jeff Bonar
Learning R&D Center
University of Pittsburgh
Pittsburgh, PA 15260

Dr. Beth Adelson
Department of Computer Science
Tufts University
Medford, MA 02155

Dr. Eva L. Baker
Ctr. for the Study of Evaluation
145 Moore Hall, UCLA
Los Angeles, CA 90024

Dr. Gordon H. Bower
Department of Psychology
Stanford University
Stanford, CA 94306

AFOSR,
Life Sciences Directorate
Bolling Air Force Base
Washington, DC 20332

prof. dott. Bruno G. Bara
Unita di ricerca di intelligenza artificiale
Universita di Milano
20122 Milano - via F. Sforza 23 ITALY

Dr. Robert Breaux
Code N-095R
Naval Training Systems Center
Orlando, FL 32813

Dr. Robert Ahlers
Human Factors Lab., Code N711
Naval Training Systems Center
Orlando, FL 32813

Dr. William M. Bart
Dept. of Ed. Psych., 330 Burton Hall
178 Pillsbury Dr., S.E.
Minneapolis, MN 55455

Dr. Shirley Brice Heath
School of Education
Stanford University
Stanford, CA 94305

Dr. Ed Aiken
Navy Personnel R&D Center
San Diego, CA 92152-6800

Leo Beltracchi
U. S. Nuclear Regulatory Comm.
Washington, DC 20555

Dr. John S. Brown
XEROX Palo Alto Research Center
3333 Coyote Hill Road
Palo Alto, CA 94304

Dr. John R. Anderson
Department of Psychology
Carnegie-Mellon University
Pittsburgh, PA 15213

Dr. Mark H. Bickhard
University of Texas
EDB 504 Ed. Psych
Austin, TX 78712

Dr. Ann Brown
Ctr for the Study of Reading
51 Gerty Drive, Univ of Illinois
Champaign, IL 61820

Dr. James Anderson
Brown University
Center for Neural Science
Providence, RI 02912

Dr. Gautam Biswas
Department of Computer Science
University of South Carolina
Columbia, SC 29208

Dr. Bruce Buchanan
Computer Science Department
Stanford University
Stanford, CA 94305

Dr. Steve Andriole
George Mason U/Info Tech & Eng
4400 University Dr.
Fairfax, VA 22030

Dr. John Black
Teachers College, Columbia Univ.
525 West 121st Street
New York, NY 10027

Maj. Hugh Burns
AFHRL/IDE
Lowry AFB, CO 80230-5000

Dr. Garv Aston-Jones
Dept. of Biology, N.Y.U.
1009 Main Bldg., Washington Sq.
New York, NY 10063

Dr. R. Darrell Bock
University of Chicago, NORC
6030 South Ellis
Chicago, IL 60637

Dr. Patricia A. Butler
OERI
555 New Jersey Avenue, NW
Washington, DC 20208

Dr. Patricia Baggett
Dept. of Psych., Box 345
University of Colorado
Boulder, CO 80309

Dr. Sue Bogner
Army Research Institute, (PERI-SF)
5001 Eisenhower Avenue
Alexandria, VA 22333-5600

Dr. Joseph C. Cambione
Ctr. for the Study of Reading
51 Gerty Dr., Univ. of Illinois
Champaign, IL 61820

Joanne Capper
Center for Research into Practice
1718 Connecticut Ave., N.W.
Washington, DC 20009

Chair, Dept of Psych
Georgetown University
Washington, DC 20057

Dr. Charles Clifton
Dept of Psych, Tobin Hall
University of Massachusetts
Amherst, MA 01003

Dr. Jaime Carbonell
Carnegie-Mellon University
Department of Psychology
Pittsburgh, PA 15213

Chair, Dept of Psych
George Mason University
Fairfax, VA 22030

Dr. Allan M. Collins
Bolt Beranek & Newman, Inc.
50 Moulton Street
Cambridge, MA 02138

Dr. Susan Carey
Harvard Grad. School of Ed.
337 Gutman Library, Appian Way
Cambridge, MA 02138

Dr. Fred Chang
Navy Personnel R&D Center
Code 51
San Diego, CA 92152-6800

Dr. Stanley Collyer
Office of Naval Tech., Code 222
800 North Quincy Street
Arlington, VA 22217-5000

Dr. Pat Carpenter
Carnegie-Mellon University
Department of Psychology
Pittsburgh, PA 15213

Dr. David Chamey
English Department
Penn State University
University Park, PA 16802

Dr. William Crano
Department of Psychology
Texas A&M University
College Station, TX 77843

LCDR Robert Carter
Office of the Chief of Naval
Operations, OP-018, Pentagon
Washington, DC 20350-2000

Dr. Paul R. Chatelier
OUSDRE
Pentagon
Washington, DC 20350-2000

Bryan Dallman
3400 TTW/TTGXS
Lowry AFB, CO 80230-5000

Chair
Dept of Computer Sciences
U.S. Naval Academy
Annapolis, MD 21402

Dr. Michelene Chi
University of Pittsburgh, L.R.D.C.
3939 O'Hara Street
Pittsburgh, PA 15213

Dr. Laura Davis
NRL/NCARAI Code 7510
4555 Overlook Ave., S.W.
Washington, DC 20375-5000

Chair
Department of Psychology
Towson State University
Towson, MD 21204

Dr. L. J. Chmura
Comp. Sci. and Syst. Branch
Naval Research Lab.
Washington, DC 20375-5000

Defense Technical
Information Center (Attn. T. C.)
Cameron Station, Bldg. 5
Alexandria, VA 22314 (12 copies)

Chair, Department of
Computer Science
Towson State University
Towson, MD 21204

Mr. Raymond E. Christal
AFHRL/MOE
Brooks AFB
San Antonio, TX 78235

Dr. Natalie Denn
Dept. of Comp. and Info. Science
University of Oregon
Eugene, OR 97403

Chair, Dept of Psych
The Johns Hopkins University
Baltimore, MD 21218

Dr. Yee-Yeen Chu
Perceptronics, Inc.
21111 Erwin Street
Woodland Hills, CA 91367-3713

Dr. Gerald F. DeJong
A.I. Grp., Coordinated Sci. Lab.
University of Illinois
Urbana, IL 61801

Chair, Dept of Psych
College of Arts and Sciences
Catholic University of America
Washington, DC 20064

Dr. William Clancey
Knowledge Syst. Lab., Stanford U.
701 Welch Rd., Bldg. C
Palo Alto, CA 94304

Georg Delacoste
Dir. de L'Info. Sci. et Techn., CNRS
15, Quai Anatole France
75700 Paris FRANCE

Department
of Computer Science
Naval Postgraduate School
Monterey, CA 93940

Dr. Richard Duran
School of Education
University of California
Santa Barbara, CA 93106

Dr. Paul Feltovich
So Illinois Univ, Sch of Med
Med Educ Dept, P.O. Box 444
Springfield, IL 62708

Dr. Sharon Derry
Department of Psychology
Florida State University
Tallahassee, FL 32303

Dr. John Ellis
Navy Personnel R&D Center
San Diego, CA 92252

Mr. Wallace Feurzeig
Ed Tech Ctr, Bolt Beranek & Newman
10 Moulton Street
Cambridge, MA 02238

Director
Manpower and Personnel Lab
NPRDC (Code 06)
San Diego, CA 92152-6800

Dr. Susan Embretson
University of Kansas
Psych. Dept., 426 Fraser
Lawrence, KS 66045

Dr. Gerhard Fischer
Department of Psychology
University of Colorado
Boulder, CO 80309

Director
Training Laboratory
NPRDC (Code 05)
San Diego, CA 92152-6800

Dr. Randy Engle
Department of Psychology
University of South Carolina
Columbia, SC 29208

Fleet Support Office,
NPRDC (Code 301)
San Diego, CA 92152-6800

Director, Human Factors
& Organizational Systems Lab
NPRDC (Code 07)
San Diego, CA 92152-6800

Dr. Susan Epstein
Hunter College
144 S. Mountain Avenue
Montclair, NJ 07042

J. D. Fletcher
9931 Corsica Street
Vienna, VA 22180

Dr. Andrea A. diSessa
School of Education, EMST
University of California
Berkeley, CA 94720

ERIC Facility
Acquisitions
4833 Rugby Avenue
Bethesda, MD 20014

Dr. Linda Flower
Carnegie-Mellon University
Department of English
Pittsburgh, PA 15213

Dr. R. K. Dismukes
Associate Director for Life Sciences
AFOSR, Bolling AFB
Washington, DC 20332

Dr. K. Anders Ericsson
University of Colorado
Department of Psychology
Boulder, CO 80309

Dr. Kenneth D. Fortus
Dept of Comp Sci, U of Illinois
1304 West Springfield Avenue
Urbana, IL 61801

Dr. Stephanie Ogan
Code 5021
Naval Air Development Center
Warminster, PA 18974-5000

Dr. Jean Claude Falmagne
Department of Psychology
New York University
New York, NY 10003

Dr. Barbara A. Fox
University of Colorado
Department of Linguistics
Boulder, CO 80309

Dr. Emanuel Donchin
University of Illinois
Department of Psychology
Champaign, IL 61820

Dr. Beatrice J. Farr
Army Research Institute
5001 Eisenhower Avenue
Alexandria, VA 22333

Dr. John R. Frederiksen
Bolt Beranek & Newman
50 Moulton Street
Cambridge, MA 02138

Dr. Thomas M. Duffy
Communications Design Center
CMU, Schenley Park
Pittsburgh, PA 15213

Dr. Pat Fedendo
Code 511
NPRDC
San Diego, CA 92152-6800

Dr. Norman Frederiksen
Educational Testing Service
Princeton, NJ 08541

Dr. Michael Friendly
Psych Dept, York University
Toronto Ontario
CANADA M3J 1P3

Dr. Wayne Gray
Army Research Institute
5001 Eisenhower Avenue
Alexandria, VA 22333

Professor John R. Hayes
Carnegie-Mellon University
Dept of Psychology, Schenley Park
Pittsburgh, PA 15213

Julie A. Gadsden
Info Tech and Applications Div
Admiralty Research Est
Portsmouth, Portsmouth PO6 4AA U.K.

Dr. James G. Greeno
School of Education
Stanford University
Stanford, CA 94305

Dr. Barbara Hayes-Roth
Dept of Computer Science
Stanford University
Stanford, CA 94305

Dr. Michael Genesereth
Stanford University
Computer Science Department
Stanford, CA 94305

Dr. Dik Gregory
Behavioral Sciences Division
Admiralty Research Est
Teddington, Middlesex ENGLAND

Dr. Frederick Hayes-Roth
Teknowledge
525 University Avenue
Palo Alto, CA 94301

Dr. Dedre Gentner
Dept of Psych, U of Illinois
603 E Daniel Street
Champaign, IL 61820

Dr. Gerhard Grossing
Atominstut
Schuttlstrasse 115
Vienna, AUSTRIA a-1020

Dr. Joan I. Heller
505 Haddon Road
Oakland, CA 94606

Dr. Robert Glaser
University of Pittsburgh, LRDC
3939 O'Hara Street
Pittsburgh, PA 15260

Prof. Edward Haertel
School of Education
Stanford University
Stanford, CA 94305

Dr. Jim Hollan
Intelligent Systems Group
Inst for Cog Sci (C-015), UCSD
La Jolla, CA 92093

Dr. Arthur M. Glenberg
WJ Brogden Psych Bldg
1202 W Johnson St. U of Wisconsin
Madison, WI 53706

Dr. Henry M. Halff
Halff Resources, Inc.
4918 33rd Road, North
Arlington, VA 22207

Dr. Melissa Holland
ARI for the Behavioral and Soc Sci
5001 Eisenhower Ave.
Alexandria, VA 22333

Dr. Sam Glucksberg
Dept of Psych, Green Hall
Princeton University
Princeton, NJ 08540

Dr. Ronald K. Hambleton
Prof of Ed and Psych
U of Mass at Amherst, Hills House
Amherst, MA 01003

Dr. Keith Holyoak
Human Performance Center
U of Michigan, 330 Packard Rd.
Ann Arbor, MI 48109

Dr. Susan Goldman
University of California
Santa Barbara, CA 93106

Steve Harnad, Editor
The Behavioral and Brain Sciences
20 Nassau Street, Suite 240
Princeton, NJ 08540

Ms. Julia S. Hough
Lawrence Erlbaum Associates
6012 Greene Street
Philadelphia, PA 19144

Dr. Sherril Gott
AFHRL MODJ
Brooks AFB, TX 78235

Dr. Wayne Harvey
SRI International
333 Ravenswood Ave, Rm B-S324
Menlo Park, CA 94025

Dr. James Howard, Dept of Psych
Human Performance Lab.
Catholic University of America
Washington, DC 20064

Dr. T. Govindaraj
Georgia Institute of Technology
Sch of Industrial & Syst Eng
Atlanta, GA 30332

Dr. Reid Hastie
Northwestern University
Department of Psychology
Evanston, IL 60201

Dr. Earl Hunt
Department of Psychology
University of Washington
Seattle, WA 98105

Dr. Ed Hutchins
Intelligent Systems Group
Inst for Cog Sci (C-015), UCSD
La Jolla, CA 92093

Dr. Douglas A. Jones
Thatcher Jones Assoc.
P.O. Box 6640, 10 Trafalgar Ct.
Lawrenceville, NJ 08648

Dr. Peter Kincaid
Training Analysis & Eval Group
Department of the Navy
Orlando, FL 32813

Dr. Barbara Hutson
Virginia Tech Graduate Center
2590 Telestar Ct
Falls Church, VA 22042

Dr. Marcel Just
Carnegie-Mellon University
Dept of Psych, Schenley Park
Pittsburgh, PA 15213

Dr. Walter Kintsch
Dept of Psych, Campus Box 3-5
University of Colorado
Boulder, CO 80309

Dr. Barbel Inhelder
University of Geneva
Geneva SWITZERLAND 12U-4

Dr. Daniel Kahneman
The U of BC, Dept of Psych
#154-2053 Main Mall
Vancouver, BC CANADA V6T 1Y7

Dr. David Klahr
Carnegie-Mellon University
Dept of Psych, Schenley Park
Pittsburgh, PA 15213

Dr. Dillon Inouye
WICAT Education Institute
Provo, UT 84057

Dr. Ruth Kanfer
Dept of Psych, Elliot Hall
75 E River Rd, U of Minnesota
Minneapolis, MN 55455

Dr. Mazie Knerr
Training Research Div, Hum Res
1100 S. Washington
Alexandria, VA 22314

Dr. Alice Isen
Department of Psychology
University of Maryland
Catonsville, MD 21228

Dr. Mary Grace Kantowski
University of Florida, Math Ed
359 Norman Hall
Gainesville, FL 32611

Dr. Janet L. Kolodner
Georgia Institute of Technology
School of Info & Comp Sci
Atlanta, GA 30332

Dr. Robert Jannarone
Department of Psychology
University of South Carolina
Columbia, SC 29208

Dr. Milton S. Katz
Army Research Institute
5001 Eisenhower Avenue
Alexandria, VA 22333

Dr. Stephen Kosslyn
Harvard U, 1236 William James Ha
33 Kirkland St
Cambridge, MA 02138

Dr. Claude Janvier, Directeur, CIRAJ
Universite' du Quebec a Montreal
Montreal, Quebec H3C 3P8
CANADA

Dr. Frank Keil
Department of Psychology
Cornell University
Ithaca, NY 14853

Dr. Kenneth Kotovsky, Dept of Psych
Comm Coll of Allegheny Co
800 Allegheny Avenue
Pittsburgh, PA 15233

Dr. Robin Jeffries
Hewlett-Packard Laboratories
P.O. Box 10490
Palo Alto, CA 94303-0971

Dr. Wendy Kellogg
IBM T. J. Watson Research Center
P.O. Box 218
Yorktown Heights, NY 10598

Dr. David H. Krantz
2 Washington Square Village
Apt. #15J
New York, NY 10012

Dr. Robert Jernigan
Decision Resource Systems
5595 Vantage Point Road
Columbia, MD 21044

Dr. Dennis Kibler
Dept of Info and Comp Sci
University of California
Irvine, CA 92717

Dr. Benjamin Kuipers
U of TX at Austin, Dept of Comp Sci
T.S. Painter Hall 3.29
Austin, TX 78712

Margaret Jerome
c/o Dr. Peter Chandler
83, The Drive
Hove, Sussex UNITED KINGDOM

Dr. David Kieras
Tech Comm, Coll of Engineering
1223 E. Engineering Bldg, U of MI
Ann Arbor, MI 48109

Dr. David R. Lambert
Naval Ocean Syst Ctr, Code 4117
271 Catalina Boulevard
San Diego, CA 92152-5800

Dr. Pat Langley
Dept of Info & Comp Sci
University of California
Irvine, CA 92717

Dr. Clayton Lewis
Dept of Comp Sci, Campus Box 430
University of Colorado
Boulder, CO 80309

Dr. Barbara Means
Human Resources Research Org
1100 South Washington
Alexandria, VA 22314

Dr. Marcy Lansman
U of NC, Davis Hall 013A
The L.L. Thurstone Lab.
Chapel Hill, NC 27514

Library
Naval Training Systems Center
Orlando, FL 32813

Dr. Douglas L. Medin
Dept of Psych, U of Illinois
603 E. Daniel Street
Champaign, IL 61820

Dr. Jill Larkin
Carnegie-Mellon University
Department of Psychology
Pittsburgh, PA 15213

Library, NPRDC
Code P201L
San Diego, CA 92152-6800

Military Asst for Training
& Personnel Tech, OUSD (R & E)
Room 3D129, The Pentagon
Washington, DC 20301-3080

Dr. Jean Lave
School of Social Sciences
University of California
Irvine, CA 92717

Dr. Jane Mallin
Mail Code SR 111
NASA Johnson Space Center
Houston, TX 77058

Dr. George A. Miller
Dept of Psych, Green Hall
Princeton University
Princeton, NJ 08540

Dr. Robert Lawler
Information Sciences, FRL
GTE Labs, Inc., 40 Sylvan Road
Waltham, MA 02254

Dr. William L. Maloy
Chief of Naval Education
and Training, Naval Air Station
Pensacola, FL 32508

Dr. William Montague
NPRDC Code 13
San Diego, CA 92152

Dr. Alan M. Lesgold
University of Pittsburgh, LRDC
3939 O'Hara Street
Pittsburgh, PA 15260

Dr. Sandra P. Marshall
Department of Psychology
San Diego State University
San Diego, CA 92182

Dr. Allen Munro
Behavioral Tech Labs - USC
1845 S. Elena Avenue, 4th Floor
Redondo Beach, CA 90277

Dr. Jim Levin
Dept of Ed Psych, 210 Ed Bldg
1310 So Sixth St
Champaign, IL 61810-6990

Dr. Manton M. Matthews
Department of Computer Science
University of South Carolina
Columbia, SC 29208

Dr. Allen Newell
Carnegie-Mellon University
Dept of Psych, Schenley Park
Pittsburgh, PA 15213

Dr. John Levine
University of Pittsburgh, LRDC
3939 O'Hara Street
Pittsburgh, PA 15260

Dr. Richard E. Mayer
Department of Psychology
University of California
Santa Barbara, CA 93106

Dr. Richard E. Nisbett
University of Michigan
Inst for Social Research, Rm. 525
Ann Arbor, MI 48109

Dr. Michael Levine
Ed Psych, 210 Education Bldg
University of Illinois
Champaign, IL 61820

Dr. Joe McLachlan
Navy Personnel R&D Center
San Diego, CA 92152-6800

Dr. Mary Jo Nissen
University of Minnesota
N218 Elliott Hall
Minneapolis, MN 55455

Matt Lewis
Department of Psychology
Carnegie-Mellon University
Pittsburgh, PA 15213

Dr. James McMichael
Assistant for MPT Research,
Dev, and Studies, OP-0187
Washington, DC 20370

Dr. Harold F. O'Neil, Jr.
School of Ed, WPH 801
Dept of Ed Psych & Tech - USC
Los Angeles, CA 90089-0031

Dr. Michael Oberlin
Naval Training Systems Center
Code 711
Orlando, FL 32813-7100

Dr. Virginia E. Pendergrass
Code 711
Naval Training Systems Center
Orlando, FL 32813-7100

Dr. Joseph Psotka
ATTN: PERI-1C
Army Research Institute
5001 Eisenhower Avenue

Office of Naval Research
Code 1142
800 North Quincy Street
Arlington, VA 22217-5000

Dr. David N. Perkins
Educational Technology Center
337 Gutman Library, Appian Way
Cambridge, MA 02138

Psychologist
Office of Naval Research
Branch Office, London, Box 39
FPO New York, NY 09510

Office of Naval Research
Code 1133
800 North Quincy Street
Arlington, VA 22217-5000

Dr. Nancy Perry, Chief
Naval Ed. and Training, Code 00A2A
Naval Station Pensacola
Pensacola, FL 32508

Psychologist
Office of Naval Research
Liaison Office, Far East
APO San Francisco, CA 96303

Dr. Stellan Ohlsson
University of Pittsburgh, LRDC
3939 O'Hara Street
Pittsburgh, PA 15213

Dr. Steven Pinker
Department of Psychology
E10-018, MIT
Cambridge, MA 02139

Dr. Lynne Reder
Department of Psychology
Carnegie-Mellon University
Schenley Park

Dr. Judith Orasanu
Army Research Institute
5001 Eisenhower Avenue
Alexandria, VA 22333

Dr. Tjeerd Plomp
Twente U of Tech, Dept of Ed
P.O. Box 217, 7500 AE ENSCHEDE
THE NETHERLANDS

Dr. James A. Reggia
Sch of Med, Dept of Neurology
22 So Greene St. U of Maryland
Baltimore, MD 21201

Professor Seymour Papert
20C-109
MIT
Cambridge, MA 02139

Dr. Martha Polson
Dept of Psych, Campus Box 346
University of Colorado
Boulder, CO 80309

Dr. Frederick Reif
Physics Department
University of California
Berkeley, CA 94720

Dr. James Paulson
Dept of Psych, Portland State U
P. O. Box 751
Portland, OR 97207

Dr. Peter Polson
University of Colorado
Department of Psychology
Boulder, CO 80309

Dr. Lauren Resnick
University of Pittsburgh, LRDC
3939 O'Hara Street
Pittsburgh, PA 15213

Dr. Roy Pea
Bank Street College of Education
510 West 112th Street
New York, NY 10025

Dr. Steven E. Pollock
MCC, Echelon Bldg #1
9430 Research Blvd
Austin, TX 78759-6509

Dr. Gil Ricard
Mail Stop C04-14
Grumman Aerospace Corp.
Bethpage, NY 11714

Dr. Douglas Pearse
DC:EM
Box 2000
Downsview, Ontario CANADA

Dr. Harry E. Pople
U of Pittsburgh, Decision Syst Lab
1360 Scaife Hall
Pittsburgh, PA 15261

Mark Richer
1041 Lake Street
San Francisco, CA 94118

Dr. James W. Pellegrino
Department of Psychology
University of California
Santa Barbara, CA 93106

Dr. Mary C. Potter
Department of Psychology
MIT (E-10-032)
Cambridge, MA 02139

Dr. Mary S. Riley
Program in Cognitive Science
Ctr for Human Info Processing, UCSC
La Jolla, CA 92093

Dr. Linda G. Roberts, Sci. Ed.
& Trans Prog, Tech Assessment
Congress of the United States
Washington, DC 20510

Dr. Judith Segal
OERI
555 New Jersey Avenue, NW
Washington, DC 20208

Special Asst for Marine
Corps Matters, ONR Code 00MC
800 North Quincy Street
Arlington, VA 22217-5000

Dr. William B. Rouse
Search Technology, Inc.
25-b Technology Park/Atlanta
Norcross, GA 30092

Dr. Sylvia A. S. Shatto
Department of Computer Science
Towson State University
Towson, MD 21204

Dr. Kathryn T. Spooner
Brown University
Department of Psychology
Providence, RI 02912

Dr. David Rumelhart
Ctr. for Human Info. Processing
University of California
La Jolla, CA 92093

Dr. Ben Shneiderman
Department of Computer Science
University of Maryland
College Park, MD 20742

Dr. Robert Sternberg
Dept of Psych, Yale University
Box 11A, Yale Station
New Haven, CT 06520

Dr. Roger Schank
Comp Sci Dept, Yale University
P.O. Box 2158
New Haven, CT 06520

Dr. Lee Shulman
Stanford University
1040 Cathcart Way
Stanford, CA 94305

Dr. Albert Stevens
Bolt Beranek & Newman, Inc.
10 Moulton Street
Cambridge, MA 02238

Dr. Walter Schneider
University of Pittsburgh, LRDC
3939 O'Hara Street
Pittsburgh, PA 15260

Dr. Robert Siegler
Carnegie-Mellon University
Dept of Psych, Schenley Park
Pittsburgh, PA 15213

Dr. Thomas Sticht
Navy Personnel R&D Center
San Diego, CA 92152-6800

Dr. Alan H. Schoenfeld
Department of Education, EMST
University of California
Berkeley, CA 94720

Dr. Derek Sleeman
Stanford University
School of Education
Stanford, CA 94305

Dr. John Tangney
AFOSR/NL
Bolling AFB, DC 20332

Dr. Janet Schofield
University of Pittsburgh, LRDC
3939 O'Hara Street
Pittsburgh, PA 15260

Dr. Edward E. Smith
Bolt Beranek & Newman, Inc.
50 Moulton Street
Cambridge, MA 02138

Dr. Kikumi Tatsuoka
CERL
252 Engineering Research Lab.
Urbana, IL 61801

Karen A. Schriver
Department of English
Carnegie-Mellon University
Pittsburgh, PA 15213

Dr. Richard E. Snow
Department of Psychology
Stanford University
Stanford, CA 94308

Technical Director, ARI
5001 Eisenhower Avenue
Alexandria, VA 22333

Dr. Judah L. Schwartz
MIT
20C-120
Cambridge, MA 02139

Dr. Elliot Soloway
Comp Sci Dept, Yale University
P.O. Box 2158
New Haven, CT 06520

Dr. Perry W. Thorndyke
FMC Corp., Central Engineering Labs
1185 Coleman Avenue, Box 580
Santa Clara, CA 95052

Dr. Marc Sebrechts
Department of Psychology
Wesleyan University
Middletown, CT 06475

Dr. Richard Sorensen
Navy Personnel R & D Center
San Diego, CA 92152-6800

Professor Chu Tien-Chen
Mathematics Department
National Taiwan University
Taipei, TAIWAN

Dr. Douglas Towne
Behavioral Technology Labs
1845 S. Elena Avenue
Recondo Beach, CA 90277

Dr. Robert A. Wisher
Army Inst. for the Beh. and Soc. Sci.
5001 Eisenhower Avenue
Alexandria, VA 22333

Dr. Kurt Van Lehn
Carnegie-Mellon University
Dept of Psych, Schenley Park
Pittsburgh, PA 15213

Mr. John H. Wolfe
Navy Personnel R & D Center
San Diego, CA 92152

Dr. Beth Warren
Bolt Beranek & Newman, Inc.
50 Moulton Street
Cambridge, MA 02138

Dr. Wallace Wulfeck, III
Navy Personnel R & D Center
San Diego, CA 92152-6800

Dr. Donald Weitzman
MITRE
1820 Dolley Madison Blvd.
MacLean, VA 22102

Dr. Joe Yasatuke
AFHRL/LAT
Lowry AFB, CO 80230

Dr. Keith T. Wescount
FMC Corp. Central Engineering Labs
1185 Coleman Ave. Box 580
Santa Clara, CA 95052

Dr. Masoud Yazdani
Department of Computer Science
University of Exeter
Exeter EX4 4QL Devon, ENGLAND

Dr. Douglas Wetzel
Code 12
Navy Personnel R&D Center
San Diego, CA 92152-6800

Mr. Carl York
System Development Foundation
181 Lytton Avenue, Suite 210
Palo Alto, CA 94301

Dr. Barbara White
Bolt Beranek & Newman, Inc.
10 Moulton Street
Cambridge, MA 02238

Dr. Joseph L. Young
Memory & Cognitive Processes
National Science Foundation
Washington, DC 20550

Dr. Christopher Wickens
Department of Psychology
University of Illinois
Champaign, IL 61820

Dr. Heather Wild
Naval Air Development Center
Code 6021
Warminster, PA 18974-5000

Dr. Michael Williams
IntelliCorp
1975 El Camino Real West
Mountain View, CA 94040-2216