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Technical Report 755

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Towards Enhancing Written Communication Skills in the Army: Cognitive and Metacognitive Perspective

Linda Baker
University of Maryland

**Technologies for Skill Acquisition and Retention
Training Research Laboratory**



U. S. Army

Research Institute for the Behavioral and Social Sciences

August 1987

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This report presents a selective review of the psychological literature on writing. The aim is to provide an overview of pertinent research findings and instructional technology to assist in the development of effective programs for enhancing soldiers' written communication skills. The first section of the report focuses on issues of writing competence in the Army. The second reviews basic research on cognitive and metacognitive aspects of writing. The final section is concerned with instructional implications and focuses primarily on the potential contributions of computer software. K...					
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Towards Enhancing Written Communication Skills in the Army: Cognitive and Metacognitive Perspective

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FOREWORD

This report presents a selective review of research on writing and focuses on issues of writing competence in the Army and basic research on cognitive and metacognitive aspects of writing. This effort was monitored by the U.S. Army Research Institute's Instructional Technology Systems Technical Area, whose mission is to support the development of more effective approaches to Army literacy instruction and the improvement of soldiers' job-related cognitive skills. The task for which this research was undertaken is entitled, "Literacy Skills for NCO Development and Job Performance," and is organized under the "Train the Force" program area. Providing sponsorship for this effort was the Education Division, Office of the Deputy Chief of Staff for Personnel (ODCSPER), under the letter of agreement, "Coordination of Efforts to Provide Literacy Training Required for Effective NCO Career Development." Information in this report was presented to the Education Division, ODCSPER, and the Army Writing Program, United States Army Training and Doctrine Command (TRADOC). The findings should be useful to training developers seeking to design effective programs for enhancing soldiers' written communication skills.



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Technical Director



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TOWARDS ENHANCING WRITTEN COMMUNICATION SKILLS IN THE ARMY: COGNITIVE AND METACOGNITIVE PERSPECTIVES

EXECUTIVE SUMMARY

Requirement:

To provide a foundation for the development of effective programs to enhance soldiers' written communication skills, this report reviews pertinent research on the cognitive and metacognitive aspects of writing and available instructional technology for improving writing.

Procedure:

The report is divided into three major sections. The first section focuses specifically on issues of writing competence in the Army, examines some of the existing curricula in the Basic Skills Education Program (BSEP), and illustrates the variety of basic research on cognitive and metacognitive aspects of writing. Included here are discussions of models of writing, component processes (e.g., planning, translating, reviewing), capacity limitations, and audience sensitivity. The final section is concerned with instructional strategies and focuses primarily on computer implementations.

Findings:

Rudimentary skills of spelling and grammatical construction have received the most attention in the Army's instructional programs to date. There is little emphasis on the higher level cognitive and metacognitive processes involved in writing, such as planning and evaluating. Although it is true that some soldiers indeed require remediation in the basic skills of writing, there are other soldiers who have command of the basic skills yet still produce ineffective written communications. These soldiers stand to benefit most from instructional software packages such as text editors, writer's aids, and idea processors.

Utilization of Findings:

The findings are relevant to military personnel or training developers seeking to improve soldiers' written communication skills.

TOWARDS ENHANCING WRITTEN COMMUNICATIONS SKILLS IN THE ARMY:
COGNITIVE AND METACOGNITIVE PERSPECTIVES

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Towards Enhancing Written Communication Skills in the Army: Cognitive and Metacognitive Perspectives

Overview

Rationale

The Army Research Institute's (ARI) Science and Technology Plan for FY 1988-1992 includes a task entitled, "Literacy Skills for NCO and Officer Development and Job Performance." The rationale for the task is that deficiencies in literacy skills, defined as reading, writing, listening and oral communication, have been documented among both commissioned and noncommissioned officers (NCOs). Moreover, literacy deficits are thought to be a major cause of attrition in NCO training programs. The objectives of the ARI project are to determine the underlying skills required for NCO and officer literacy and to develop and evaluate literacy programs using cost-effective instructional technology.

The purpose of the present paper is to summarize existing research on one of these literacy skills, writing, in order to provide a foundation for the ARI project. The paper will focus on writing because ARI to date has been less involved with writing skills than reading skills and therefore should find a synthesis of writing research more useful. The paper will also consider the limited information that is available regarding the nature of writing problems in the Army and the current approaches taken by the Army to foster writing skills.

Contributions of Psychology to the Study of Writing

While it is certainly important for an individual to be able to spell correctly and to use appropriate punctuation and grammar, these are skills that can become fairly well automatized through drill and practice, much as basic decoding or word recognition skills become automatized through practice (Martlew, 1983; Samuels, 1977). Instructional techniques for providing such practice are fairly well-established and there appears to be little need for psychologists to focus their efforts on these components of writing. Rather, psychologists can make a greater contribution by focusing on the higher level cognitive skills involved in writing. Indeed, within the past decade, the influence of psychology has become apparent. An early paper by Bruce, Collins, Rubin, and Gentner (1978) documented the value of a cognitive approach to writing and de Beaugrande (1982) offered a compelling discussion of the past and future contributions of psychology to the study of composition. Although the number of psychologists actively engaged in writing research is still fairly small, a great many educators, linguists, and composition

specialists have been influenced by cognitive psychology and so the field of writing has witnessed an influx of psychological terms and concepts. A sure sign of impact is the fact that the cognitive approach has been incorporated into writing textbooks. For example, Flower (1985) has published a text for college composition students which presents many strategies for improving writing based on psychological principles of problem solving, creativity, and comprehension.

Although psychological principles predominate in current theoretical analyses of the writing process, application of psychological principles to empirical research on writing is still in its infancy. Much of this work has been descriptive in nature, providing valuable characterizations of on-line writing processes and insights into differences between proficient and less proficient writers. A central focus of experimental efforts has been to document the information processing demands of the various components of the writing task. An emerging concern is to examine the metacognitive aspects of writing, both in terms of the knowledge an individual possesses about the skills required for effective writing and in terms of the self-regulatory strategies an individual uses to orchestrate, evaluate, and regulate his or her own writing activities. A limited number of instructional intervention studies have been conducted, designed primarily to improve the component skills of children's writing as opposed to adults'. Nevertheless, these studies are valuable for their potential generalizability to older populations of less-skilled writers.

Psychological perspectives on writing are also becoming apparent in instructional technology, specifically with respect to computer software designed to enhance written communication skills. However, much of this software is designed on an intuitive basis; we lack a firm empirical foundation for evaluating the effectiveness of many of the techniques and there has been relatively little field testing of many of these instructional packages.

This paper will examine some of the theory, research, and applications mentioned above. The coverage is not intended to be exhaustive but rather illustrative of the kinds of contributions that psychologists have made to the study of writing. To provide an appropriate context, I will first consider some of the problems that ARI will need to address as they begin their literacy project, such as how writing competence should be defined. I will also discuss the nature of writing instruction as it currently exists in the Army, and I will present some samples of soldiers' writing to illustrate the variety of writing difficulties which might be encountered at different ranks.

Writing in the Army: What Skills are Needed?

How Should Writing Competence Be Defined?

At the present time, there is very little information available about the literacy requirements of NCOs and officers, nor is there apparently any more than informal, anecdotal evidence about the exact nature of the problems which do exist. The information gap is probably greater with respect to the expressive components of literacy (writing and speaking) than the receptive components (reading and listening). One of the major reasons for the difference in the availability of information about reading and writing is that assessment instruments for reading are much easier to design, administer, and score than assessment instruments for writing. Moreover, it is common practice to characterize instructional materials according to their grade level of reading difficulty and to characterize an individual's reading skills according to grade level. Discrepancies between the two measures are taken as evidence of a reading comprehension deficit of a particular magnitude (e.g., if the materials have an average readability level of 11th grade, and the individual is reading at the 9th grade level, then the individual is said to show a reading-level deficit of two years). One can similarly quantify the goal of remedial instruction (e.g., the individual's reading level must be improved by at least two years). Although there are a number of theoretical and practical objections to this sort of quantification, the fact remains that it can and has been done, using fairly objective criteria.

Characterizing the nature of a writing deficit is a much more formidable task. It is obviously not possible to speak in terms of grade-level equivalents in writing. Objective tests which have been developed to assess writing skill, such as the Test of Standard Written English (TSWE), focus on knowledge of the conventions and rules of written language rather than on the student's ability to use those conventions and rules productively. Efforts to develop standardized tests which actually require the student to write have been fraught with controversy because of the difficulty in establishing objective scoring systems. The approach taken by the Educational Testing Service (ETS) is typical. ETS uses a procedure known as "socialized holistic scoring" (Hirsch & Harrington, 1981). A select committee gives exemplary scores to papers written on a single topic. The criteria for the scores are not specified; rather, the group decides through example which papers should receive scores of 1, 2, 3 or 4. Panels of subreaders are then trained by the committee. The problem, of course, is that the criteria are unstated and may well be different than those that would have been established had the committee membership been different. Many states are currently grappling with the issue as they attempt to institute functional writing proficiency as a requirement for high school graduation. The Department of

Education in Maryland recently faced an embarrassing incident when a newspaper published two student writing samples collected in pilot testing, one of which received a passing score, the other a failing score. The passing sample was considered terribly written by most readers of the newspaper, whereas the failing sample, written by an honors student, was considered perfectly acceptable. The ensuing controversy prompted the legislature to postpone instituting the requirement pending further refinement of the scoring system.

It should be clear that developing an adequate definition of writing competence will not be a simple task. (See, for further discussion, Charney, 1984; Hirsch & Harrington, 1981; Mosenthal, 1983.) It is fairly easy to ascertain whether an individual can spell, punctuate, and construct reasonably grammatical sentences. But is this competent writing? Most would agree that spelling, punctuation, and grammar skills provide valuable tools for effective writing, but possession of these skills is no guarantee that an individual will be able to communicate effectively. To meet the Army's needs, the definition of writing competence should be task specific. This would of course necessitate thorough analysis of the kinds of writing tasks that NCOs and officers are required to perform. Hirsch and Harrington suggest a measure of intrinsic communicative effectiveness which could serve as a model, based on the idea that writing be judged according to how well it does what it is supposed to do. They argue that judges should be able to apply non-arbitrary standards intrinsic to a particular piece of writing, considering both its purpose and the characteristics of the intended audience in evaluating how well it conveys its meaning.

The military is well aware of the magnitude of the literacy problems among its recruits. According to a recent article in the New York Times (Hechinger, July 8, 1986), an unpublished survey of 1983 and 1984 Naval recruits revealed that more than 20% were unable to read at the 9th grade level. In order to deal with comparable literacy problems, the Army established a Basic Skills Education Program (BSEP) to provide what is essentially remedial education. The bulk of these efforts are directed towards reading deficits rather than writing deficits. This may in fact be an appropriate allocation of effort at the entry level, given that soldiers in all military occupational specialties (MOS) must be able to read in order to learn how to perform their specific tasks and deal with on-the-job problems. What writing instruction does exist in BSEP programs is geared towards rudimentary skills such as grammar, spelling and punctuation. Perhaps this low-level focus is appropriate, given that instruction should be oriented towards the kinds of tasks that the soldiers will need to perform. The writing demands for most MOS may be limited to filling out simple forms where the ability to spell, punctuate, and capitalize properly may be sufficient.

Although the necessary level of writing competence to perform entry-level jobs may be fairly low, as the soldier gains more responsibility, the demands for writing on the job increase. The Army has become aware that NCOs need better communication skills--both oral and written--to carry out their jobs as leaders and teachers. The final report of a study on NCO professional development (NCO, February 1986) indicates that NCOs themselves perceive a need for more training in communication. Fully 95% of the NCOs interviewed indicated a need for courses which enhance their ability to communicate (read, write, and speak). Senior commanders perceived similar needs. The report also includes anecdotal comments about writing problems that interfere with job performance. For example, one of the important duties of many NCOs is to write Enlisted Evaluation Reports (EER) about the personnel serving under them which are used for promotions, assignments, school selection, etc. An integral part of these reports is a narrative section. Complaints were made about the poor quality of the writing in these narratives, and soldiers were concerned that they would not be fairly evaluated because their superior officer was either unwilling or unable to communicate effectively. The report concludes with the recommendation that the Army evaluate the existing educational system for NCOs to determine the adequacy of instruction in writing as well as other basic educational skills. Such an evaluation will presumably be a part of ARI's planned task.

The Nature of Writing Instruction in BSEP

In order to define the training requirements for BSEP, a needs assessment for the Army was completed by RCA in 1984. RCA identified prerequisite competencies and developed a series of tests designed to tap those competencies. Several of the competencies dealt with various aspects of writing and will be listed below. It is important to note that although many higher-level writing skills are included, the BSEP curricula that actually have been developed tend to focus on the lower level aspects of writing such as spelling and grammar. In addition, many of the competencies are relevant for both writing and speaking; in other words, they are general communication skills.

Competencies concerned with lower-level aspects of writing:

- Spell frequently used words correctly
- Spell task-related words correctly
- Identify words that need to be capitalized
- Correct all misspelled words with or without the use of a reference source
- Apply all rules of end marks, commas, and apostrophes
- Apply common rules of grammar

Competencies concerned with report writing:

- State the intent or objectives of the report
- Describe the parameters of the event or situation
- Distinguish between relevant and irrelevant details
- Sequence events in the order they have occurred
- State general impression of events described
- Select examples that will clarify major issues presented in the report
- Summarize the major points developed in the report
- Justify an action taken and give reasons for rejecting alternatives

Competencies concerned with revising

- Rewrite the paragraph by stating the main idea in the first sentence and restructuring the ideas for coherence
- Appraise an entire written communication and make adjustments to improve clarity

Competencies concerned with metacognitive knowledge about communication:

- Use technical vocabulary suitable to the task and level of the person
- Determine the appropriate amount of information to communicate
- Solicit feedback to confirm the accurate reception of the communication
- Recognize the need for clear concise directions in order to avoid language or word meaning differences
- Recognize feedback as a means of communicating more effectively and increasing task competence
- Recognize when the situation will require a structured, preplanned method of presentation
- Recognize when low-key informal dialog is suitable
- Recognize when direct verbal commands are necessary
- Recognize when a prescribed series of verbal interactions is required in order to coordinate a group effort

The American Institutes for Research (AIR) has recently completed an evaluation of the Army Basic Skills Education Program (BSEP) for ARI (Hahn, Krug, Rosenbaum, Stoddart, & Harman, 1986). The final report lists the subjects taught in BSEP II curricula that have been developed by Temple University, Murray State University, Central Texas College, the Fort Lewis Experiment, and McFann, Gray, and Associates (original and revised). It also lists the prerequisite competencies of the Job Skills Education Program (JSEP) that are based on the RCA needs assessment and describes two Functional Basic Skills Education Program (FBSEP) courses, for MOS 05C (radio teletype operator) and MOS 31M (multichannel communications operator).

All of the regular BSEP II curricula include some form of writing instruction, with a major emphasis on basic components

such as spelling, punctuation, capitalization, and grammar. It is difficult to get a good sense of exactly what was taught in these programs on the basis of topic listings, but it is clear that very little, if any, attention was given to higher-level cognitive processes such as planning, evaluating, and revising. In fact, only the JSEP listing included any components that could be termed "metacognitive". It was also the only listing to include specific reference to the target audience. However, several of the curricula did differentiate among different types of writing. For example, the Murray State program dealt with "how-to" paragraphs, military suggestion forms, formal requests, and personal affairs correspondence. The original McFann, Gray and Associates curriculum did not include any instruction in anything but the basics, but the revised program deals with different types of writing tasks such as reports and descriptions. However, the instructional objectives are quite modest: tasks are to write brief reports and short descriptive paragraphs which "show correct spelling, sentence structure, and organization using nonmilitary and military tasks." The Army apparently intends to implement the McFann, Gray, and Associates curriculum at all BSEP II installations, but it is not at all clear that this writing curriculum will be sufficient in boosting writing skills prior to NCO training.

The two FBSEP courses provide instruction specifically tailored to job demands. It was interesting to note that the curricula did include skills which are clearly metacognitive: the radio teletype operator (05C) must be able to decide if information is missing in a message or if a message is in error. Similarly, the multichannel communications equipment operator (31M) must be able to recognize when important information is missing. These evaluation skills are clearly crucial to effective job performance in these two MOS, but they are also important to effective communication in other domains as well.

Some Illustrations of Soldiers' Writing Problems

As a first step in identifying the nature of writing difficulties among today's soldiers, I sought and obtained samples of soldiers' writing from some of my colleagues at ARI. The samples should not be regarded as representative of the populations from which they were drawn, nor, at least for two sets of samples, should they be regarded as representative of the soldiers who actually produced them. This is because some of the writing was done in response to requests for comments during field testing of new training instruments and lessons. In other words, the writing task was very informal; the writers could appropriately assume a great deal of shared knowledge with the reader and in fact the discourse structure is more similar in some ways to oral communication than written. The writing samples were obtained from military personnel of four different ranks. The first set of excerpts to be presented below was obtained from enlisted men with less than five years of service who had been identified as needing remedial basic skills education. The

second set of excerpts was obtained from NCOs who were tank commanders. The third set was obtained from a single West Point cadet. This is an illustration of a formal piece of academic writing: a paper for a course. The final writing sample, which will not be excerpted, was also obtained from a single individual, a colonel, and represents a formal piece of job-related writing.

The following comments were solicited from soldiers as they completed basic skills lessons presented on the PLATO system. They were asked to provide constructive criticism about individual lessons and were specifically instructed not to worry about spelling and mechanics. Thus, the writing does not necessarily represent the level of competence these soldiers may exhibit had they been trying to write a carefully planned and edited commentary. However, the errors that are present do suggest that the lower-level skills of writing are not well-automatized. Another caveat in interpretation is that the soldiers were keyboarding the comments; thus, many of the errors may be typographical errors and not true reflections of underlying skill deficits.

1. I think that this graphic guy runs to far and way to slow. I'm quite sure that we get the idea about the VERB, RUN!! Reprogram it to run only have way through the screen. Not to mention the jeep moves even slower than the guy. If you were to think about it, some of these graphics are unnecessary. It would cut down a great deal of time and get the course over with. Not to mention the money that is being spent to waste such time writing up these programs and time that us individuals are spending sitting here.
2. By giving the right answeare the computer, felt that it was necessary to mark the question wrong. Please look into this type of error a little more carefully when putting lessions together.
3. It was on page 9 that this computer marked one of the answers wrong, when it was in all reality right all the time.
4. The long lesson on Ratio's and proportions doesn't explain enough of the math. I had to have assistance from _____ to get through this lesson. Please change this lesson so people can understand what there suppose to do.
5. Your graphics are extremely to slow. Speed things up. This is not a very exciting class you know and we would like to get it over with. Iam very greatful for all the excellent programs on the graphics but it is to time consuming. It would really be better if you had speed it up or just take out all together.

6. Before I take this test I would like to comment on this section. I can already read a map like the back of my hand I have been reading a map since I was in high school I know how to measure distance. Getting to the point when we got here you said not to touch the screen with nothing except your finger. Know it wants me to put paper and pencil on it when it even a flat surface. So either I punch a hole in the screen or I get the answer wrong. Its inaccurate to begin with. CHANGE IT.

7. This is the test for the long lesson on the formula's section T. I have went through this long lesson 4 times and I still dont no how to do these formula's. After the 4th time and I dont no any more than before it keeps putting me back through the lessons. Please get me out of this.

(Note--Comments 1 and 5 were by the same individual, as were comments 2 and 3 and comments 4 and 7.)

The second set of samples was obtained from NCOs serving as tank commanders. They participated in an evaluation of a new computerized training instrument called the Hand Held Training Aid (HHTA). They were asked to answer some general questions about their reactions to the HHTA. Although the soldiers were not given explicit instructions to ignore spelling and mechanics, as were the soldiers commenting about the PLATO lessons, the implicit demands of this writing task were also informal. Accordingly, the same caveats are in order with respect to what these writing samples tell us about the writing competence of NCOs.

8. What I liked the best about this piece of equipment is the material covered in reference to gunnery and TC's position. What I liked the least is that it gets boring after an hour or so. It is kind of tiring to be reading for a long period of time. The material covered should be condensed some how and if possible, it should be divided into two phases; one for experienced gunners and tank commanders and one for novice or inexperienced stage, per say, trainees, reclass, reserves, ect. ect.

9. The HHTA can be the teaching aid of the future. it is designed to take a man that has no knowledge and can help to train him in the proper up to date standards. The HHTA is also a good refresher it can help a tanker Study for SQT, gunnerys, and help better skills.

10. Tuter: The HHAT seem's like A helpful devices for A freshup for NOC's that don't have Experience With tanks or in a Training Enviroment, and be Educational for trainies. I really don't see anything that's wrong with the machine plus I really don't know to much A bout tanks most less Fire Commands but it did help me out A lot and buitt up my confidents.

11. Well I think that it is a good piece of equipment Because By Retaking the Test alot of the information Came back from Recall from doing excise. from the equipment.that I used. I think That it caN Help! a lot of Troops Because it will explain What you did Wrong and Now to correct yourself.

12. I liked the tutor it was easy to use and I remember things longer when I hear it rather than read it. it could use some type of RESET button but it was still a good thing to use. It has good possibilities in my opinion. The game part of the tutor was a good ideal also. It makes you want to learn because nobody likes loseing and you have to know what your doing to win.

13. The Hand Held Trainer Aid is a very helpful piece of equipment. The HHTA help me clear up the small problems I had with my fire commands. There really isn't any problems with the HHTA. It's designed to be used by people who are not computer programmers. I's simple and very easy to operate. I'm sure that is would do wonders for personel who have problem with the written SQT Test which the army is getting into recently. So I want the owners of HHTA to keep pushing to get this device within the army's educational system.

Following are excerpts of a paper written by a West Point cadet enrolled in an advanced (400-level) course and submitted in partial fulfillment of course requirements. The paper is formatted as a final project report following Army guidelines.

14. The smarter the computer has been the dream of those who study computer science. A computer that acts and thinks like a human has not been totally realized yet. However, the idea of developing computer software that goes beyond number crunching purposes has begun to surface. Representing and utilizing information in a way which makes possible the processing of knowledge, not just data, and the automation of how the world works, not just how it is constructed, continues to be the emphasis in a field known as artificial intelligence.

15. How artificial intelligence can aid our Army followed by a case study implementation of it are the purposes of my study and this report.

16. Yesterday's standards and their application lead one to believe that computer emulation of human reasoning potential is infeasible. Rid yourself of this misnomer, for artificial intelligence hs a place in our future.

17. Traditionally, applications in the computer field have dealt with direct computing. The pitfall of continuing to

use computers for this sole purpose resides in the recognition that most of today's problems cannot be solved through direct computation.

18. Since expertise is knowing what to do, programs will have to know what they are doing.

19. This discussion of expert system terms has been quick and brief, but to delve further into an explanation would require a rather lengthy composition.

20. Our Nation, as a superpower, has taken an important role in the world society and through the help of artificial intelligence expert systems, the goal of world peace and welfare have taken on a new perspective.

21. To summarize the results of my software and study would simply be to state that I have accomplished all objectives set forth in this report's executive summary.

These isolated portions of text do not fully capture this student's difficulties with effective writing. The overall structure of his paper is weak, especially in terms of paragraph cohesiveness. The writing skills of this student are clearly competent in terms of lower level features of spelling, grammar, punctuation and capitalization. In that respect, he is well beyond the level of the enlisted personnel whose comments were listed earlier. However, as a future officer, his communication demands will undoubtedly be greater. Whatever formal writing instruction he had at West Point has already been received.

As noted earlier, I also obtained a writing sample from a colonel. This was a formal report intended to document a long-term strategy for training and training development. I will not include actual excerpts from the report for two reasons: first, to protect confidentiality and second, because the problems with this report cannot be illustrated with short excerpts. The basic problem is at the level of overall structure. Individual sentences are generally well-formed, and most of the paragraphs are cohesive. However, each paragraph exists as an independent entity, with no transitions leading from one main point to another. For the most part the paragraphs could be reordered without substantially altering the effect created by the document. The opening paragraph of the report consists of a single statement of purpose--to document the long range strategy. The writer does not explicate a plan of organization nor is it possible to infer one. He gives no rationale for including particular points. The paper ends as abruptly as it began, with no summary or conclusion paragraph included. The writer does not display sensitivity to the needs of his audience in terms of providing them with explicit statements of goals and explicit connections among ideas. These are strategies recommended by Flower (1985) and others for improving communicative effectiveness. Presumably the intent of

this document was to persuade the audience that the training plan should be implemented; however, its lack of cohesiveness makes it fail in its rhetorical purpose.

In fairness to the officer, it should be noted that his style of writing appears to be consistent with Army guidelines. As a reviewer of this paper observed, the Army encourages this type of writing by requiring professionals and officers to write their memos, reports, and letters with "independent" paragraphs, often numbered. Such a requirement can be detrimental to effective communication because it absolves the writer of the need to be explicit about his or her logical organization.

Cognitive and Metacognitive Processes in Writing

Research Approaches

The first study of cognitive processes in writing is usually attributed to Emig (1971), a composition specialist who observed and tape recorded high school students as they composed orally and commented about their cognitive activities. A few additional studies were done in the 1970's, but it was not until this decade that cognitive process research became well established. Part of the reason for the late entry of writing research into the field of psychology reflects the behaviorist bias towards studying only directly observable events. Product-based measures of writing would have been acceptable, and in fact were characteristic of research by composition specialists, but psychologists did not seem particularly interested in the topic of writing. However, with the growth of cognitive psychology in the 1970's and a renewed concern with such educationally-relevant skills as reading, writing came to be a legitimate domain of inquiry as well. Much of the research to date has been conducted by non-psychologists, although there appears to be a trend towards greater involvement by psychologists, frequently working as part of an interdisciplinary team.

Researchers interested in the study of cognitive processes in writing have had to sacrifice rigid experimental control in favor of more subjective forms of inquiry. A review paper by Humes (1983) summarizes the basic methodology used by researchers and indicates some of the concerns that have been raised about the various approaches. The major criticism has to do with the validity of using verbal responses as indicators of underlying cognitive activity (e.g., Cooper & Holzman, 1985; Tomlinson, 1984). Given that verbal protocols have been used in other domains of cognitive research, this is an issue that has been debated vigorously. However, there is a growing consensus that verbal reports are valuable sources of data providing they are collected in adherence with certain guidelines (cf. Simon and Erickson, 1984). Much of our available information about cognitive processes in writing is indeed based on verbal reports, typically collected as the subject is in the process of composing. For example, Flower and Hayes have used this

"think-aloud" protocol method extensively in developing their model of the composing process. Subjects are instructed to verbalize all of their thoughts and feelings as they engage in a writing task. The transcribed protocols are used to characterize the variety of strategies subjects engage in as they write. However, it is important to recognize the limitations of protocol analysis; the protocols can provide insights into cognitive processing but they should not be regarded as complete descriptions.

Another technique for studying process is to collect real-time measures of writing behavior. The use of real-time measures of reading behavior, such as reading times and patterns of eye movements, has become well established and has influenced writing researchers to study pause patterns, body language, and amount of time required for completion of various phases of the writing task (e.g., Martlew, 1983; Matsuhashi, 1982). Collection of real-time measures should be greatly facilitated by computer technology and word processing systems. The computer could record pause times between key strokes and could record the pattern of movement through the text (i. e., as the subject revises). To my knowledge, this type of research has not yet been published. (However, Matsuhashi currently has an edited book in press entitled, "Writing in real time." Some of the latest technology is undoubtedly described in these chapters.)

Component Processes in Writing

Cognitive Process Models. Several different models of cognitive processes in writing have been developed, with somewhat different terminology, but the basic underlying assumptions are comparable. Perhaps the most fundamental assumption is that writing is not a linear process that can be characterized as a sequence of discrete stages. This is contrary to earlier views that composing consisted of three fixed-sequence stages: pre-writing, writing, and post-writing. The pre-writing stage involves planning what one wants to say; the writing stage involves translating one's ideas into words and putting them down on paper, and the post-writing stage involves reviewing and revising what has been written. Although current models continue to distinguish among the three basic processes of planning, translating, and revising, they stress that the processes do not occur at specified times. For example, writers typically start with planning, followed by translating. However, they may then do some more planning and go on to revise what they had written. They may plan again, translate, plan, translate, revise, and so on. In short, the component processes are recursive.

Flower and Hayes (1981a) are typically credited with the first elaborated cognitive process model of writing, and so I will use their model as the primary basis of discussion. The model is based on their assumption that: "Writing is best understood as a set of distinctive thinking processes which writers orchestrate or organize during the act of composing."

Represented in the model are three basic processes: planning, translating, and reviewing. Within the planning component are three subprocesses: generating ideas, organizing ideas, and setting goals. Within the reviewing component are two subprocesses: evaluating and revising. The model also includes a monitor, which determines when the writer moves from one process to another. Whereas some models simply use a flow chart with feedback loops among the three basic processes (e.g., Bruce, Collins, Rubin, & Gentner, 1978; Nold, 1981), the Flower and Hayes model explicitly recognizes the need for an executive controller (the monitor) to orchestrate these processes.

The model also represents the role of the task environment in interaction with these writing processes. Two different features of the task environment are specified. The rhetorical problem itself plays a critical role: What is the topic, audience, and exigency of the document to be written? The writer must bear these questions in mind throughout the writing process. The text produced so far is also a key feature of the task environment. The writer constantly modifies his text in response to what has already been written. Additional features of the task environment not specified in the model include external aids such as instructions and books (e.g., Martlew, 1983), which are likely to play a particularly important role in job-related writing.

Finally, the model represents the role of the writer's long term memory. Key aspects include knowledge of topic, audience, and writing plans. A crucial long-term memory component that is not specified in this model is linguistic knowledge. The models of Bruce et al (1978), Martlew (1983), and Nold (1981) indicate that the writer must have syntactic and semantic knowledge for successful translation of ideas into prose, as well as linguistic skills specific to writing (e.g., spelling, punctuation, capitalization). Another long-term memory component which is not represented in the model but which Flower and Hayes have come to recognize as important (e.g., Hayes, Flower, Schriver, Stratman, & Carey, in press) is metacognitive knowledge about the writing process. Such a component is specifically included in Martlew's (1983) model of the writing process and in many recent theoretical discussions of writing (e.g., Bracewell, 1983; Langer, 1986a; Scardamalia & Bereiter, 1983).

We turn now to a more detailed discussion of each of the component processes. Basic research findings will be summarized, with special attention to expert-novice differences. I make no claim of exhaustiveness in this section; rather, my goal is to familiarize the reader with the kinds of research questions which have been addressed.

Planning. Flower and Hayes (1981b) consider writing to be a form of problem solving and argue that the advantages of plans are common to any problem-solving endeavor: (1) They break a task down into subproblems, thereby making it more manageable;

(2) They specify a sequence of procedures to be used for solving a problem; (3) They establish priorities and an order for doing things. The authors discuss three basic types of plans involved in writing, identified on the basis of think-aloud protocols collected from college students as they wrote. The three types are plans for generating ideas, plans for producing a paper, and plans for controlling the composing act. Some of the plans within each type are procedural (content-free) and others are content specific. For example, a procedural plan for generating ideas is to brainstorm. A content-specific plan for generating ideas is to pursue an interesting idea that had already been generated. Plans for producing a paper include procedural plans such as deciding to defer editing until some future time and content-specific plans such as deciding to organize the ideas one has generated. Procedural plans for controlling the composing act include plans to switch plans and plans to map one plan upon another.

Research on planning has provided convincing evidence that writing is not a linear activity. Although planning of course is the first component process to occur, planning also occurs frequently once the writer has begun to translate. In fact, writers generally spend more time planning once they have begun producing text than before they begin to write. It appears that planning occupies a substantial proportion of total composing time, with some estimates as high as 65% (e.g., Gould, 1980).

Matsushashi (1982) has studied planning by analyzing pause patterns during writing. She found that there are different types of planning patterns depending on the writer's purpose for writing. For example, reporting requires less planning time than generalizing, presumably because it is a more straightforward and structured task. The length of a pause is related to the type of planning which occurs. For example, long pauses accompanied by gazing or rereading and by removal of the pen from the page correspond to global decisions about overall purpose and structure rather than local decisions about individual words and sentences.

Research has shown that expert and novice writers are distinguished by the amount of time spent planning and the nature of the plans generated. Stallard (1976) reports that good writers spend more time planning than average or poor writers. Good writers also focus more on global planning, while poor writers focus more on local planning (Atwell, 1981, Martlew, 1983). Bereiter and Scardamalia (1981) label this sort of local planning the "What next" strategy and note that it is characteristic of elementary school children.

Bereiter and Scardamalia have developed a technique called "procedural facilitation" to enhance children's writing skills, which may be applicable to adult novices as well. As applied to planning, the technique involves providing the writer with a series of prompts designed to facilitate idea generation,

improvement, and elaboration (Scardamalia, Bereiter, & Steinbach, 1984). Examples of prompts serving each of these functions, respectively, are: "A different aspect would be..."; "This isn't very convincing because..."; and "I could develop this idea by adding..."

Translating. The term "translation" is used to refer to the process of transforming meaning from one symbol system (thought) to another (graphic representation). (Another frequently used label for this process is "transcription".) The translation process, in contrast to planning or reviewing, is perhaps most amenable to improvement through drill and practice. Because the products of translation are readily observable, skill deficits can be unambiguously identified. Moreover, the skills of translation are more rule-based than those of planning or reviewing. Thus, a writer can be taught a set of basic rules for spelling, punctuation, sentence structure, and so on, which can be applied whatever the specific task demands.

Even once the basic skills are mastered, writers would benefit from additional practice to foster automaticity. The advantages of automaticity with respect to translation have been noted by many researchers (e.g., Humes, 1983; Martlew, 1983; Nold, 1981). The argument is similar to that frequently made with respect to reading (e.g., Samuels, 1977): automaticity in word recognition processes enables greater attention to higher-level comprehension processes. Analogously, if a writer does not need to allocate much conscious attention to spelling, word choice, or sentence structure, he or she has more cognitive capacity available to devote to global aspects of the task. (The cognitive capacity issue is addressed more fully in a subsequent section.) It is recognized that such automaticity requires many years and much practice in order to develop.

Discussions of the complexity of the translation process focus on the number of different constraints writers must attend to simultaneously. For example, Nystrand (1982) has identified constraints at five different levels: graphic, syntactic, semantic, textual, and contextual. The higher-level constraints are typically sacrificed when the writer is not proficient in the lower-level skills of translation. Thus, novices allocate attention to graphic and syntactic features of their text at the expense of textual features (which require attention to global structure and coherence) and contextual features (which require attention to rhetorical goals such as audience and purpose).

Reviewing. The reviewing phase of the composing process has recently begun to receive a great deal of research attention. Hayes et al (in press) and Flower et al (1986) have discussed the reviewing process extensively, detailing the sophisticated strategies subjects use in detecting problems with their texts, diagnosing the problems, and revising accordingly. Scardamalia and Bereiter (1983) and Scardamalia, Bereiter, and Steinbach (1984) have studied what they call the CDO process (compare,

diagnose, and operate) which occurs during the reviewing phase. They have used procedural facilitation techniques to enhance children's skills of reviewing in addition to planning.

The skills of reviewing are perhaps the most metacognitive of all writing skills. Writers must be able to stand back and objectively appraise what they have written. They must adopt appropriate criteria for deciding whether the text is adequate and they must know appropriate ways for dealing with whatever deficiencies they detect. These processes are quite similar to those regarded as components of comprehension monitoring: evaluation, where readers decide how well they understand the text; and regulation, where readers deal with whatever difficulties have been detected (e.g., Baker & Brown, 1984). In fact, Flower et al (1986) and Hayes et al (in press) identify many of the same criteria as important in evaluating one's own compositions as Baker (1985) has identified as important in evaluating one's own comprehension.

There is a substantial amount of literature dealing with differences between expert and novice writers in their reviewing or revising processes. This literature is summarized by Humes (1983), Hayes et al (in press) and Flower et al (1986). Some of the major differences will be discussed briefly. Better writers spend proportionately more time in revision than poorer writers (e.g., Pianko, 1979). When novices do revise, the changes seldom improve the quality of the text (e.g., Scardamalia & Bereiter, 1983). Experts attend more to global problems than novices. Most of the revisions made by novices consist of error corrections or else they consist of sentence-level changes that involve replacement of individual words or phrases. Few of the changes actually affect the meaning of the text (e.g., Beach, 1976; Faigley & Witte, 1981; Stallard, 1976). Other research has shown that when novices review for problems, they frequently fail to detect them. For example, poorer writers often read what they intended to write rather than what they actually did write (Daiute, 1981). In addition, they often have trouble finding errors in their own texts that are apparent to them in the texts of others (Bartlett, 1982). Finally, even once they identify a problem, they seem to think that nothing more is necessary, as Beach (1976) found in his analysis of self-evaluations. The non-revisers in his study did not describe how they would deal with problems they detected, nor did they attempt to rectify them.

Based on an analysis of students' written drafts and revisions, Schwartz (1983) has identified three different revision profiles. Each profile corresponds to a different aspect of revision. The first is concerned with language production and generation and includes two types: the overwriter, who says too much at first and needs to cut out excess prose in revision, and the underwriter, who does not say enough and needs to flesh out his or her text during revision. Both types are appropriate for successful writing, as long as the writer is capable of making the necessary modifications. The

second profile is concerned with structural reformulation. Four different types are specified here: the restarter, who rejects the text he or she has written and starts again; the recopier, who accepts the text as is with perhaps a few minor changes; the rearranger, who pieces together old sections of text to create a new structure; and the remodeler, who builds on the original structure by adding and subtracting. Schwartz (1983) suggests that all of these restructuring strategies should be available to the proficient writer, who can shift from strategy to strategy as appropriate. The third profile is concerned with content reassessment and includes three different types. The first is the censor, who is concerned with audience and purpose; the second is the refiner, who judges the accuracy and clarity of the text; the third is the copy editor, who assesses the correctness of form based on rules of spelling and grammar. Schwartz argues that all three reassessment strategies are also necessary for successful writing, but they must be used at the appropriate time with the appropriate balance. For example, if either the censor or the copy editor is used too early, text production could be disrupted. Novices have a tendency to be overly concerned with these aspects of text revision at the expense of refinement. Schwartz argues that students would benefit from being instructed about these profiles as a way of helping them understand what to do when their writing is not progressing well. In other words, she is arguing that metacognitive knowledge would be valuable in helping students select appropriate revising strategies.

We turn now to detailed consideration of the model of revision developed by Hayes and Flower (Flower et al, 1986; Hayes et al, in press). The model is an elaboration of the cognitive process model described earlier. Recall that the original review component included evaluation and revision as two subprocesses. The more recent conceptualization specifies several subprocesses within revision, including task definition, evaluation, strategy selection, and modification of the text or plan. The process model was based on analysis of think-aloud protocols collected while students and professional writers revised a text and explained the changes they made. The task for the subjects was to modify a letter written for one audience into a handout appropriate for another audience. The letter contained 26 intentionally-introduced errors of spelling, diction, and grammar. The subjects were also tested for their ability to detect the errors out of context one week later. (This type of error detection task has been used frequently in studies of comprehension monitoring.)

The first revision process, task definition, shows differences between novices and experts in what they understand about improving a text. Experts have more knowledge about how to make process plans to guide task performance, as in making an inventory of problems to return to later rather than attempt to deal with them immediately. Consistent with previous research, Hayes et al found that the experts' task definitions were more likely to include global goals that take into account the

communicative purpose of the text. Experts also seem to be better able to adjust their definitions of the task of revision in response to problems found in the text; that is, they show more flexibility. The novices failed to notice many of the embedded problems in the text. Hayes et al suggest this may be due to their narrow task definitions. For example, if a writer does not conceive of revision as involving audience considerations, then he or she will be unlikely to notice problems at this level. This suggestion is comparable to the comprehension monitoring research: poor readers often fail to detect problems involving more global aspects of a text because they do not define comprehension as involving sensitivity to such features. Hayes et al identify four skills novices need to learn with respect to task definitions: 1) what information to attend to in the text as they revise; 2) how to set goals and make plans for revising; 3) how to monitor their attention while they are working; and 4) to attend to the purpose of the communication and problems associated with this purpose.

The evaluation subprocess entails most of the same component processes involved in reading for comprehension; however, the goal of reading one's own text is to comprehend and criticize. The processes and the results of their use are as follows: decode words (to detect spelling faults); apply grammar knowledge (to detect grammar faults); apply semantic knowledge (to detect ambiguities and reference problems); make instantiations and factual inferences (to detect faulty logic and inconsistencies); use schemas for world knowledge (to detect errors of fact and schema violations); apply genre conventions (to detect faulty text structure); infer gist (to detect incoherence); infer writer's intentions and point of view (to detect disorganization); and consider audience needs (to detect inappropriate tone or complexity). The only component which is not involved in reading another's texts for comprehension is the last, consideration of audience needs. These components are very similar to the standards described by Baker as essential for evaluating one's own comprehension. Moreover, empirical research has shown that use of these criteria can lead to detection of the text problems identified by Hayes et al (cf., Baker, 1985).

Included within the evaluation phase of revision are two important subprocesses: detection and diagnosis. Detection of problems within the text may be at a very general level, with perhaps only a vague feeling that something is wrong. In such cases, the problem representation is ill-defined. If diagnosis occurs, the writer has identified the exact nature of the problem; the problem representation is therefore well-defined. Hayes et al found that novices differ from experts in both diagnosis and detection. Overall, novices detected only 26% of the intentionally embedded errors in the texts they were asked to revise. Instead of revising sentence by sentence, as the novices did, the experts rewrote large segments of text. Therefore, it was not possible to come up with a comparable error detection rate. However, it was clear that experts detected more global

problems than novices, as well as more sentence-level problems. When the writers were asked to diagnose the planted problems presented in single-sentence contexts, experts correctly diagnosed 53% of the problems and novices 23%. These low figures are rather typical of those found in parallel studies of comprehension monitoring involving proficient and less proficient readers (Baker, 1985). Deliberate evaluation of the adequacy of written texts is a very resource-consuming task, and it depends heavily on the application of appropriate standards of evaluation.

The strategy selection component of the model identifies five different actions that can be taken to manage revision: ignore the problem; delay action; search for more information to solve the problem; rewrite (i.e., abandon the existing text completely and write another draft to capture the gist) or revise (i.e., work with existing text, making local modifications). Hayes et al discuss the sophisticated decision processes involved in making an appropriate strategy selection, stressing that flexibility is important. The revision goals of novices are less elaborated than the goals of experts, as are the means for accomplishing them. In general, novices have a more limited range of strategies for dealing with a more limited range of problems.

Overall, the research considered in this section provides a rich source of information about the complex cognitive and metacognitive processes involved in writing. Differences between novices and experts are abundant. However, it may be possible to remediate many of the problems of novice writers by instructing them in strategies for evaluating texts and for dealing with problems which have been found. Just as efforts to improve the evaluation and regulation of comprehension have met with some success (e.g., Palincsar & Brown, 1984), so too should intervention be successful with composition. Indeed, Scardamalia and Bereiter and their colleagues have made progress in this direction in their work with elementary school children. To my knowledge, however, no one has conducted similar intervention research with adults. Indeed, this is one area that is generally ignored in research on cognitive strategy training. In their review of the literature on systems that train learning ability, Derry & Murphy (1986) note that not a single taxonomy of learning skills includes the language production skills of writing and speaking.

Cognitive Capacity Limitations in Writing

Many researchers have argued that one of the major obstacles in writing is that there are too many cognitive demands imposed on the writer simultaneously. Several studies have examined capacity limitations in writing by using techniques common in the cognitive psychology literature. For example, researchers have used the secondary task paradigm popularized by Britton and his colleagues (e.g., Britton, Glynn, Meyer, & Penland, 1982) to

determine how the demands of writing interfere with the ability to respond to some other stimulus. Other researchers have attempted to reduce the processing demands of writing by simplifying the task in various ways and assessing the effects on writing. Others have examined the possibility that individual differences in general working memory capacity influence writing skill. This literature will be briefly summarized.

Reed, Burton and Kelly (1985) tested for differences in cognitive capacity usage among college freshmen writers with three levels of writing proficiency. The students were asked to write a persuasive, descriptive, or narrative essay. All subjects were paced through a 60-min. session divided into pre-writing, writing, and re-writing stages. At random times throughout the session, they were presented with a tone at which time they were to stop whatever they were doing and press a button as quickly as possible. The main dependent measure was the mean reaction time (RT) to the 20 tones. There were no differences in RT among writers of different skill levels for either the narrative or persuasive documents, but the pattern of differences obtained for the descriptive passages was typical of that found in comparisons of subjects with varying levels of expertise in a domain. The honors writers and the remedial writers both used less cognitive capacity on this task than the average writers. The interpretation of these data is as follows: honors writers have a well developed schema for writing descriptive passages and so such writing can be performed almost automatically, requiring little cognitive capacity. Average writers are in the process of developing a schema for descriptive writing and so need to devote a great deal of attention to the task. Remedial writers find the task very difficult and because the skills of writing are not well integrated, they have extra processing capacity available for performing other tasks.

The Reed et al study is weakened by its failure to consider how cognitive capacity usage varied at different points in the writing process. Instead, the RT measure was collapsed across the three different paced activities. A second problem is that the activities subjects were engaged in at the time the tone sounded were not considered. Perhaps the poor writers were sitting idly when the tone sounded, accounting for their faster responses. Moreover, the imposed separation of prewriting, writing, and rewriting phases is at variance with the view that composing is not a linear process that can be neatly compartmentalized.

A second investigation using a secondary-task paradigm focused specifically on differences in cognitive capacity usage during the various processes of writing. Kellogg (1986, cited in Kellogg, 1986) asked college students to write a persuasive essay. At variable intervals throughout the composing session a tone was sounded and students were to say "stop" as soon as possible. Response times for verbalization were recorded. Students were also asked to press one of four buttons to indicate

what aspect of writing they were currently engaged in: planning, translating, revising, or other. Planning, translating, and revising all showed significant amounts of capacity usage compared to a nonwriting baseline measure. Planning and revising required more capacity than translating, consistent with the idea that translating can often be done at an automatic level. Kellogg also compared the capacity expended by writing to that expended in other cognitive tasks. He compared interference difference scores (writing process minus baseline) to similar scores obtained in studies of cognitive capacity usage in learning, reading, and chess playing. Only expert chess playing consumed as much capacity as any of the three processes of writing. Thus, Kellogg's study provides good empirical evidence that writing does indeed require a great deal of cognitive effort.

A second paradigm for studying the cognitive demands of writing involves structuring the task such that some of the demands are eliminated. One such investigation was conducted by Glynn, Britton, Muth, & Dogan (1982). Glynn et al distinguished between two types of demands, those dealing with the production of content and those concerned with structure. They argued that the need to deal with both constraints would overtax processing capacity if the writing task were difficult. In their first experiment, graduate students were asked to produce a persuasive letter under one of four conditions: polished first draft; mechanics-free sentence format (ignore spelling and punctuation rules); ordered proposition (ignore both mechanics and sentence-formation; focus only on content and order); and unordered propositions (focus only on content). All subjects were subsequently asked to produce a final draft. Analysis of the number of arguments generated indicated a strong advantage of ignoring demands of sentence production and mechanics; subjects in the ordered proposition condition generated significantly more propositions than those in the first two conditions and those in the unordered propositions condition generated still more propositions.

In a second experiment, undergraduates differing in verbal ability as measured by the Scholastic Aptitude Test (SAT) were asked to write a persuasive letter under one of three instruction conditions: the polished sentence condition and the unordered proposition conditions of Experiment 1 and a control condition in which subjects were instructed to use whatever first draft writing strategy they normally prefer to use. Results revealed that lower verbal ability subjects did not benefit from the removal of structure demands in terms of the number of arguments produced, whereas the average verbal ability students did. Overall, the average ability students generated more ideas than the lower ability students. When left to select their own strategies, the average ability students usually used some form of proposition-based strategy, such as listing, outlines, diagrams, etc. In contrast, the lower ability students used such strategies infrequently; rather, the majority of the subjects

used sentence-based formats. The authors argue that this difference reflects differences in metacognitive knowledge about writing; the higher-ability students seemed to be more aware of effective allocation of processing capacity. The authors conclude that writers should be discouraged from attempting to generate finished drafts on their first effort, using instead a freewriting strategy for generating ideas only.

Although the evidence reviewed above documents the processing demands of writing, it does not indicate that writing actually overburdens the processing system. Bereiter and Scardamalia (1984) dispute claims to this effect such as that of de Beaugrande (1981): "...discourse production routinely operates near the threshold of overloading..." Bereiter and Scardamalia discuss their failed attempts to demonstrate that the demands associated with writing are excessive. For example, they used the technique of 'blind writing' to tax children's short term memory (STM) capacity. When subjects were required to write without ink in their pen (leaving an impression on blank paper underneath), there was no decrement in the quality of writing as compared to normal writing. (In fact, a recent study by Blau, 1983, revealed that adult writers valued blind writing as a technique for keeping their attention focused on the task of idea production as opposed to sentence formation and mechanics.) In further pilot work, Bereiter and Scardamalia found that children's writing was not disrupted by doing mental arithmetic between sentences or when writing two alternative sentence completions rather than one. Thus, the authors conclude, "During normal composition writers -- including young and not particularly proficient ones -- are not operating near the threshold of overload." Bereiter and Scardamalia suggest that it may be more profitable to focus on teaching novices more effective ways to put their unused processing capacity to work than to instruct them in using load-reducing strategies, as recommended by others (e.g., Flower & Hayes, 1981). Much of Bereiter and Scardamalia's own work has in fact been directed towards this end. They use the procedural facilitation technique mentioned above to aid the young writer in idea production, translation, and evaluation. The technique is aimed at breaking down the task of writing into manageable parts and aiding the novice writer in asking the right kinds of questions at various stages of the writing process.

The final study to be considered in this section takes a different tactic to the study of cognitive capacity in writing. Benton, Kraft, Glover, and Plake (1984) attempted to account for individual differences in writing skill in terms of differences in working memory capacity. They gave good and poor college writers a standard series of tasks designed to assess working memory capacity. In their first experiment, they found that good and poor writers did not differ in traditional short term memory (STM) tasks, but they did differ in a task that taxed working memory capacity. In other words, differences were revealed when subjects were expected to hold some information in memory at the

same time they operated on other information. Two subsequent experiments using tasks assumed to reflect some of the underlying components of writing revealed differences between better and poorer writers at both the college and high school level. The authors concluded that the results "...generally suggest that good writers manipulate information in STM significantly more rapidly than poor writers do," even when taking other possible differences in verbal ability into account.

The problem with Benton et al's conclusion is that the tasks used to determine working memory capacity really are not that comparable to writing. For example, the task that showed the largest difference between writers of different skill levels was a word reordering task, which required subjects to unscramble 10-word scrambled sentences as quickly as possible. Sentence reordering and paragraph construction tasks also revealed differences, but these were more modest. It seems unwarranted to argue that good writers have developed a "whole series of information processing programs that operate almost automatically as writing occurs... (p. 831)." The authors argue that their tasks have important implications for the prediction of writing skill, but it is not at all clear why such a predictive tool would be of value.

Sensitivity to the Needs of One's Audience

Virtually all models of the writing process include sensitivity to the needs of the audience as an important component (e.g., Bruce, et al., 1978; Flower & Hayes, 1981; Martlew, 1983; Nold, 1981). Writers need to take into account the needs of their audience and the level of knowledge the audience already possesses about the topic at hand. They must be able to assess what the audience will be able to understand and tailor their message appropriately. In this section, theoretical and empirical research on audience sensitivity will be considered. Particular emphasis will be given to possible reasons why writers frequently have difficulty conceptualizing and responding to an audience's needs.

In an effort to explain why children find the task of learning to write so much more difficult than learning to speak, Olson (e.g., Olson & Torrance, 1981) argued that the fundamental difference between speech and writing is that writing is decontextualized. That is, the words must stand autonomously and be capable of conveying the intended meaning without any outside support or embellishment. These arguments have been further elaborated by Bruce et al., 1978; Green & Morgan, 1981; Martlew, 1983; and Rubin, 1980. Briefly, writers do not share commonalities of space and time with their audiences as do most speakers. Therefore, they cannot rely on nonverbal support such as gestures, context, and prosodic features of speech (i.e., stress, pitch, intonation) to help them convey meaning. Moreover, they do not receive immediate feedback from the

audience, so they lack information as to how well their message is being received.

As Green and Morgan note, "A good writer is one who is aware of the reader's disadvantage in not being able to interrupt and let the writer know that the exposition isn't being followed, and who is able to make compensating adjustments in presentation (p. 187)". They also state that the good writer is a good judge of what the audience knows, is explicit about his or her intended purposes, and clarifies the logical relations among the ideas in the text. Green and Morgan argue for a pragmatic theory of communicative competence, one which accounts for how a language user tailors his or her phrasing of what is to be communicated according to assessments of the audience's ability to make the necessary inferences.

One of the problems of novice writers identified by Olson and Torrance (1981), among others, is that novices often believe that the sentence says exactly what they intended it to say; they are unaware that sentence meaning may be different from intended meaning and that the sentence may need to be reshaped to reflect intended meaning. This characteristic problem of novice writers is not restricted to children. Many adults who lack writing experience and/or proficiency show similar problems. For example, Flower et al (1986) found that college students were less likely than professional writers to revise their texts according to audience considerations.

One of the more easily quantifiable signs of insensitivity to the reader is the use of ambiguous referents. Effective use of anaphoric expressions entails assessing whether the reader will be able to establish the intended referent. Bartlett and Scribner (1981) found that more than two thirds of the children they studied, who ranged in grade level from third to sixth, used ambiguous referents in their writing. In an interesting follow-up, Bartlett (1981) found that children were better able to detect ambiguous referents in the writing of other people than in their own writing. The interpretation of this outcome is consistent with Olson's argument. Because the children knew what their intended meaning was, they had difficulty stepping back and evaluating their text from the point of view of another person. Problems of unclear reference are also apparent in the writing of adults. As Flower et al (1986) note, "Some of the most intransigent detection problems occur when the text neglects to specify something, such as a referent, that is already obvious to the writer. In reviewing, the writer can blithely "read" her intended meaning into the text."

Sensitivity to an audience's needs has also been studied by asking subjects to write messages for audiences differing along some important dimension. Using such a task, Crowhurst and Piche (1979) found that 12-year-olds used more complex syntax when writing a persuasive argument for a teacher as opposed to a friend. However, Rubin and Piche (1979) found little difference

among 15-year-olds in the approach taken in writing to audiences designated as high, intermediate and low intimacy. Martlew (1978, cited in Martlew, 1983) asked subjects to write stories for adults and for children. Her 11-year-old subjects failed to differentiate among the audiences in their stories and the 13-year-olds differentiated only by using more abstract nouns when writing for adults. Most of the adults in her sample made appropriate adaptations to their audiences; however, there were many adults who used a single differentiation strategy, the same one used by the 13-year-olds.

In a recent investigation of audience adaptation, Rafoth (1985) examined differences among college freshman identified as proficient and nonproficient writers. The students were asked to write an essay intended to persuade a specified audience why the drinking age should be raised. Half of the subjects were given detailed information about what their audience thought and felt about the drinking age issue; the remaining subjects were not given such information. The essays were scored for the extent to which subjects addressed the specific issues raised by the intended audience. Proficient writers were more likely to make their messages responsive to the thoughts and feelings of their audience than less proficient writers. There were no differences in the control condition for the two groups, which is hardly surprising given that no opportunity for adaptation was provided.

Rafoth speculates that proficient writers show more adaptation to their audience because they expend less energy attending to other aspects of the composing process and therefore have more processing capacity available for other concerns. This is consistent with the suggestion made by Bereiter and Scardamalia (1981), among others, that one reason why less-skilled writers fail to attend to higher level aspects of the composing process is that they need to allocate too much of their attention to planning and translating ideas.

Another explanation for why writers may fail to consider audience needs rests on differences in cognitive style. Williams (1985) suggested that individuals who are field dependent will be less likely to produce texts that can stand on their own, independent of any contextual support. Williams administered the Embedded Figures Test, a standard measure of field dependence, to college students enrolled in their first composition course. The subjects were also given several different types of formal and informal communication tasks, some involving speaking and some involving writing. Subjects identified as field dependent produced texts judged as less coherent than field independent students, and they made many unwarranted assumptions about their reader's background knowledge.

Yet another explanation for audience insensitivity is that less proficient writers fail to realize that they must adapt their messages to the needs of their audience and/or that they lack the skill necessary to infer what those needs are and to

adapt their message appropriately. These problems have been discussed in the literature as deficits in metacognition (e.g., Martlew, 1983) or as deficits in social cognition (e.g., Rubin, 1981; Kroll, 1985). The research approach involves correlating measures of social cognitive ability with measures of writing performance. One measure frequently used is concerned with interpersonal constructs. Subjects are asked to describe all of the characteristics of one liked peer and one disliked peer. The sum total of constructs listed is the dependent measure. However, it is not at all clear that the number of dimensions by which one describes another person is truly an adequate measure of social cognitive skill, especially as it pertains to sensitivity to one's audience in communication. Social cognition encompasses knowledge about many different dimensions of social interactions and other people.

It is perhaps because of this and other similarly limited definitions of social cognition that research has not shown consistent relations between social cognitive skill and writing skill. For example, Rubin, Piche, Michlin & Johnson (1984) reported that social cognitive skill predicted fourth grade students narrative writing skill. Similarly, Kroll (1985) found that among 9-year-olds, social cognitive ability was significantly correlated with narrative writing but not with writing in other genres (e.g., persuasive, expressive, or referential). Moreover, Burleson and Rowan (1985) found no relation between social cognitive skill and narrative writing among college students.

Another problem with this line of research is the apparent assumption that lack of social cognitive skill should manifest itself in global assessments of writing quality based on syntactic and semantic complexity. It would seem more logical to expect social cognitive skill to correlate with measures directly concerned with pragmatic aspects of communicative effectiveness. Thus, future research should include measures of social cognition and writing competence which are more clearly appropriate to the issue of audience sensitivity.

Evidence for audience adaptation in on-the-job writing is mixed. Aldrich (1982) surveyed a sample of top- and mid-level managers drawn from the military, civil service, and consulting firms. (The median rank among the military personnel surveyed was lieutenant colonel.) The managers were asked to rank order the importance of tasks listed under the heading of "Preparing to write." These tasks included determining purpose, audience, and central points to be made. Aldrich found that most people did not give these tasks very high rankings, suggesting that they failed to see the value of considering the intended audience in their writing. However, there is evidence of audience adaptation in other studies of actual on-the-job writing. For example, Odell & Goswami (1982) studied administrators and case workers in a social service agency. They collected samples of their job-related writing and interviewed them about the choices they

made with respect to the three rhetorical goals of audience, writer, and subject. All of the workers showed sensitivity to the needs of their respective audiences and tailored their messages appropriately depending on their rhetorical goals. However, all of the participants in the study had at least two years experience and were considered good in their jobs. Perhaps, as Odell and Goswami acknowledge, novice case workers would not show similar sensitivity to the needs of their audience.

The foregoing discussion may imply that writers ought to take the needs of their audience into account when they first begin to write. However, it is not clear that this is desirable. Schwartz (1983) found that poor writers often get bogged down in their writing efforts because they try to consider the response of the reader at the very outset. Flower (1979) reports that good writers often deliberately delay consideration of the reader, a strategy that enables them to deal with the task of writing in more manageable substeps.

Flower (1979) made an important distinction between what she termed writer-based prose and reader-based prose. Writer-based prose is similar to the inner speech discussed by Vygotsky; its function is to enable the writer to get his or her thoughts down on paper as expediently as possible, without using complete sentences or other conventional modes of expression. Reader-based prose, in contrast, is adapted to the needs of the reader; all propositions and assumptions are made explicit, and the text is capable of standing on its own. Although construction of reader-based prose is the ultimate goal of writing, Flower argues that it is helpful to start with writer-based prose when the task demands are high. Once the basic ideas are set down, the writer can transform the initial writer-based prose into reader-based prose.

It is clear from the literature summarized above that writing differs from speech in its need to take the audience into account; it is usually not possible to revise the communication upon immediate feedback that the message is not understood. Provision of such feedback, however, should be an effective instructional device for increasing writer's awareness of the need to be more reader responsive. Research on children's oral communication skills suggests a paradigm that might be useful. Robinson and her colleagues (e.g., Robinson, 1981) use a task in which children are asked to communicate to a listener which of several referents is to be selected. The referents are usually similar in some way, thereby requiring that the message be sufficiently explicit to allow for disambiguation. After the children have generated their message, they watch a listener attempt to select the correct referent on the basis of the message provided. Because children frequently give inadequate messages, the listener makes many errors. Until the children are about 10 years old, they typically blame the listener for selecting the wrong referent; they fail to realize that the

message did not convey the intended meaning. With feedback and practice, these listener-blamers, as Robinson calls them, are more likely to become speaker-blamers and also improve in their ability to provide informative messages. To my knowledge, no parallel research has been conducted with either children's or adults' written communication skills. It would seem that a good way for writers to discover whether their written communications are sufficiently clear would be to have them watch a reader attempt to act upon the communication, as in following a set of procedural directions.

In general, any activity designed to foster a writer's ability to distance him or herself from the text should be valuable in improving communicative effectiveness. It may in fact be possible to design some sort of interactive computer-based system which takes the role of the reader, providing feedback when communication fails and allowing the writer to attempt to tailor the message appropriately. Indeed, one of the reasons why electronic message systems are incorporated into existing computer-based writing curricula (e.g., Rubin & Bruce, 1984) is that they give the student an opportunity to write for a real audience within a meaningful context. (See the section on computers in writing instruction for further discussion of this issue.)

Instructional Strategies To Foster Writing Skills

Some Hints from Existing Textbooks on Writing

Efforts to develop instructional technology to improve soldiers' writing should of course take advantage of what has already been written on the topic. Hundreds of textbooks intended for writing instruction at the adult level have been published. An examination of several current composition texts revealed little variation in the way the topic was approached. Many were characterized by their emphasis on grammar, spelling, punctuation, and sentence structure. They gave little attention to the processes involved in writing, and they offered little in the way of concrete suggestions for improving students' strategies for writing as a means of improving their final products.

One textbook, however, proved to be an exception to these generalizations, and the reason for this is that it was authored by Linda Flower, the same individual who has done extensive research on the cognitive processes involved in writing. Flower's text, called Problem Solving Strategies for Writing, has recently come out in a second edition (1985) which incorporates the latest research findings on writing. The text is also unique in that it discusses relevant research findings from other domains of cognitive research, including problem solving, creativity, semantic memory representation, and comprehension. It is intended not only for students enrolled in college composition courses but also for people who wish to improve their job-related

writing. In short, the text seems to be an ideal reference for developing a cognitively-based program of writing instruction. For this reason, I will provide a summary of the contents of the text.

Flower begins by explaining the advantages of conceptualizing writing as a problem solving process and draws a comparison with other problem solving activities studied by cognitive psychologists. She discusses her model of the writing process (e.g., Flower & Hayes, 1980) and includes excerpts of think-aloud protocols to illustrate her points. She argues for the importance of awareness of one's own cognitive processes (i.e., metacognition): "Being aware of your own composing process and the strategies you use can give you the enormous power of conscious choice--the power to guide, test, and alter your own problem-solving process (p. 24)."

The text is organized according to nine major steps in the composing process. Each chapter is devoted to a discussion of one or two of these steps and the corresponding strategies which should be used at that point in the composing process. The strategies, according to Flower, are based on things good writers normally do when they write. Many of them, in fact, are based on research discussed earlier in this paper. Exercises are included at the end of each chapter for students to apply what they have learned.

The first four steps are concerned with planning and idea generation:

1. Explore the rhetorical problem. Included in this step is the important strategy of identifying the purpose of writing, something which is particularly crucial in job-related writing.

2. Make a plan. Included in this step is the strategy of making a goal-based plan (a plan to do) as well as a topic-based plan (a plan to say).

3. Generate new ideas. Several strategies for accomplishing this step are suggested. Some are based on creativity research, such as brainstorming, freewriting and incubating. Others are based on rhetorical principles of invention such as Aristotelian topics, tagmemics, and synectics. (These rhetorical strategies are discussed in most composition texts.)

4. Organize your ideas. One of the strategies discussed here is to "nutshell" your ideas (i.e., capture the gist) and try to teach them to someone. As Flower notes, "Nothing helps you stand back, evaluate, and reorganize your ideas more quickly than trying to teach them to someone else who doesn't understand (p. 95)." A second strategy is to build an "issue tree," a hierarchical tree structure indicating the relations among ideas. Flower discusses this strategy in some detail as a valuable aid for testing the focus and connections that the reader is likely to see.

The next two steps are concerned with designing the paper for a reader:

5. Know the needs of your reader. One strategy is to analyze the audience in terms of their knowledge, attitudes, and needs. This strategy is crucial for effective on-the-job writing. A second important strategy is to anticipate the reader's response. Flower presents a discussion of communication theory to illustrate that the writer does not simply put ideas into words which in turn are picked up by the reader exactly as intended. She discusses the research on reading as a constructive process, indicating that comprehension involves using context, making predictions, drawing inferences, and using prior knowledge. She argues that it is therefore important to write for a reader who is creative and will impose his or her own structure on the material if it is not provided explicitly. Thus, she suggests stating main ideas explicitly and using a standard pattern of organization.

6. Transform writer-based prose into reader-based prose. This step is based on Flower's (1979) paper on writer-based versus reader-based prose. She explains what she means by the two terms, indicating that it is not necessarily inadvisable to use writer-based prose initially, so long as the prose is subsequently transformed. An important strategy included in this step is to give the reader cues to facilitate comprehension. These include cues that preview the points (e.g., introduction, topic sentences), cues that summarize or illustrate the points, cues that guide the reader visually (e.g., punctuation, underlining), and cues that guide the reader verbally (e.g., transitional words, conjunctions, repetitions). (These cues are also discussed in most composition texts.)

The last three steps are concerned with revising:

7. Review your paper and your purpose. Flower presents some general comments about the revising process, discussing research evidence of major differences in the goals of experts and novices at this stage of writing. The first strategy included under this step is to compare the paper to the plan. Flower stresses the need to monitor and manage one's own revision processes, suggesting that it usually is most efficient to read for meaning and purpose first, checking for goals and gist, dealing with lower-level problems later.

8. Test and edit your writing. The strategies included under this step are to edit for economy and to edit for a forceful style. These editing suggestions are primarily directed towards sentence-level goals and are characteristic of suggestions found in many texts (e.g., avoid weak linking verbs such as the forms of "to be", use concrete words when possible, use active constructions rather than passive).

9. Edit for connections and coherence. One of the strategies here is to transform simple sentences that read like a list of equally-important points into sentences with more complex structures that signal differential emphasis. A second strategy is to reveal the logic of the paragraphs. This strategy probably would not be necessary if the writer used strategies discussed

earlier and provided cues to help readers see the logical structure of the text and the connections among ideas.

The Role of the Computer in Writing Instruction

The computer is coming to play an important role in writing instruction both directly and indirectly. The direct application is that software packages have been designed specifically for the instruction of composition skills. The indirect application is that software packages designed to facilitate the task of writing may be used to improve writing competency. These packages include text editors (word processors) and idea processors, designed to help the writer organize his or her ideas. Entire texts have been devoted to the role of the computer in writing instruction (e.g., Wresch, 1984), so I will make no effort to be exhaustive in my discussion. Rather, I will simply highlight some of the software that may be useful in enhancing writing skills.

Text editors. Text editors play an intrinsic role in software specifically designed to teach writing. This is a clear indication of their perceived value in writing instruction. For example, the QUILL system, a microcomputer-based writing curriculum for upper elementary students, includes a text editor (Writer's Assistant) as a key component (Rubin & Bruce, 1984). Collins (1986) describes several advantages of using a word processor: students are less concerned about making mistakes, students produce longer texts, texts are neater, texts are easier to revise. Moreover, the fact that most words processing systems include a spelling checker is considered an advantage because the knowledge that spelling errors can be corrected before submitting work to a teacher reduces performance anxiety and may also encourage students to use a wider vocabulary. The built-in thesaurus that goes with many systems also encourages new vocabulary learning. The grammar checkers that are parts of some packages will stimulate the use of different syntactic structures. Maddux and Cummings (1986) argue that the nonjudgmental correction afforded by word processors is one of the key strengths of writing instruction by computer as compared to traditional forms of instruction.

Whether the use of word processors actually improves students' ability to compose remains an empirical question, with some studies citing clear-cut advantages, others not. Fales (cited in Collins, 1986) reported that children paid more attention to editing spelling, punctuation, and capitalization errors when using a word processor and that they seemed to notice errors more easily. There is also evidence that children revise more and experiment more; Daiute (1982) argues that students focus more on what they want to say. Teichman (1985) describes a writing course for college freshman which required that all writing be done on a word processing system. The students generally liked the system, citing as its main advantage the greater ease of revision. They also reported less anxiety about

writing and noted that it was easier to see the logical organization of the paper and weaknesses in ideas when drafts could be read as clean copy. The main disadvantage voiced by the students was the necessity of working only in one place, the room where the computer terminals were located. Whether the word processing actually improved the written products of these students in contrast to a control group not using the word processor was unclear. The experimental students did make more revisions in their drafts, but the revisions were primarily at the surface level. (This is characteristic of many inexperienced college writers, as noted earlier.) It seems important to consider whether students have the option of revising from printed copy or whether all revision must be done at the terminal. Hayes (1986) reported that students required to compose and revise without benefit of printed copy did not revise as frequently as other students and seemed to miss many more errors.

Writer's aids. Writer's aids are programs that serve as advisors but do not actually edit a piece of text. For example, Writer's Workbench (MacDonald, Frase, Gingrich, & Keenan, 1982), written for technical writers at Bell Laboratories, includes a set of programs that can scan a document and find certain types of errors. One programs checks for diction, printing out wordy phrases. Another checks for weak "to be" verbs so that a writer can substitute richer action verbs. Another checks for spelling, while still another checks for punctuation errors. There is also a grammar checker, but the checking is limited to split infinitives. Another program checks for readability, sentence variation (number of simple, complex, and compound sentences), and sentence structure (number of passive sentences and nominalizations), and it indicates whether the distribution is appropriate. There is also a style checker which gives data concerning sentence length and word length. It is important to note that the programs do not actually implement any changes; rather, the writer must decide whether or not to adopt the recommendations and must decide upon appropriate modifications. MacDonald et al suggest that the Writer's Workbench can be potentially valuable for writing instruction, in addition to document design and assessment.

A study conducted by Sterkel, Johnson, and Sjogren (1986) was designed to test the instructional potential of writer's aid software in a writing class for business communications students. A selected set of programs from Writer's Workbench were used, and two additional programs relevant to the needs of business communications were included. The experimental sections of the course were instructed to run all of their written assignments through the programs, analyze the comments, and make whatever changes they deemed appropriate. The control subjects received no feedback from the teacher on their initial drafts. Dependent measures included assignment grades, editing skills, assignment preparation time, and attitudes towards the program. The assignments were evaluated according to several different

dimensions, such as concreteness, clarity, correctness in grammar, punctuation, and proofreading. Overall, there was little evidence of an advantage attributable to use of the Writer's Workbench. However, only 17 of the 83 items graded on the papers were addressed by the program. The students were also given a letter to edit which contained 35 errors which the students were to find and correct. Again, there were no differences between the two groups, though both improved significantly during the course of the semester. (It is difficult to evaluate this measure as no description of the errors was presented.) Students' attitudes towards the program were positive. They liked having feedback on their errors soon after making them rather than receiving negative feedback from the teachers. Again, the main negative comments had to do with difficulties scheduling computer time, waiting for print-outs, and coping with computer breakdowns.

Electronic Message Systems. One of the main advantages of a computer-based writing curriculum is that it provides the student with an opportunity to write within a meaningful context. As discussed above, one of the main obstacles facing children when they first begin to write is difficulty conceptualizing their audience and its needs. With computerized message systems, such as that included in QUILL, children use writing in order to communicate with one another. They are motivated to communicate effectively and the feedback they receive from their message recipients indicates whether the message has been understood. Publication systems provide another meaningful context for writing. For example, QUILL includes an information storage and retrieval system that enables children to write about different topics and store their documents in a library that can be accessed by other children.

To the extent that practice and feedback from one's peers can enhance writing skill, message and publication systems could also play a role in writing curricula for adults. The popularity of electronic mail systems among computer users suggests they would be well received in an instructional context. Given how rarely most adults communicate with one another in writing, this could be a valuable exercise in fostering written communication skills. Moreover, it is possible that adults would devote extra effort to their written work if they knew it would be read by classmates, and whatever anxiety they may feel about writing for an audience could be reduced somewhat if a writer's aid such as Writer's Workbench were available for use before filing the document.

Idea Processors. Idea processors are programs designed to help the writer generate and organize ideas. A recent paper by Kellogg (1986) describes the value of idea processors from a cognitive psychology perspective. This section of the paper draws heavily on Kellogg's work. Kellogg identifies three obstacles to effective writing and suggests how idea processors can help overcome each difficulty. One of the problems discussed

earlier in this paper is that writing creates a demand on processing resources, or, to use Kellogg's terms, it produces an attentional overload. To help writers deal with this problem, idea processors can serve as a funnel, channeling the writer's attention into only one or two processes. This can be accomplished by software programs that allow the writer to use outlines which can be expanded and collapsed as necessary. The goal here is to hide text that may be distracting to the writer. Another approach is to show only topic sentences, allowing the writer to get an idea of the macrostructure of the text, useful both in further planning and reviewing. The Writer's Workbench, for example, includes a program that displays the first and last sentences of each paragraph.

A second way of dealing with attentional overload is to use software that promotes freewriting. Freewriting is a technique advocated by many composition specialists and is recommended as a useful strategy for getting ideas down on paper without thorough planning or reviewing (e.g., Flower, 1985). As Glynn et al (1982) demonstrated in their earlier-cited study, students generate significantly more ideas when they are encouraged to write ideas down without regard to mechanics, sequence, or sentence structure. Von Blum and Cohen (1984) created a software package for college students called WANDAH (Writing Aid and Author's Helper) which encourages freewriting by flashing the screen when the writer pauses for too long a period of time, on the assumption that these pauses reflect planning or reviewing. Freewriting programs may be particularly useful for writers who are reluctant to write anything down until it is in polished form. WANDAH also includes another program to promote freewriting which involves blanking the screen so the text is invisible. As Blau (1983) found, invisible writing is valued by some writers as a way of focusing their attention on what they are currently saying.

Kellogg discusses a second writing difficulty which he calls "idea bankruptcy" and defines as a failure to generate usable ideas. Research has shown that writers often do have trouble generating ideas. For example, Glynn et al found that their poor writers generated very few relevant propositions to include in a persuasive letter, and Graesser, Hopkinson, Lewis, & Bruflodt (1984) found that students instructed to write down everything they knew about a topic with which they had some familiarity generated surprisingly few ideas. Programs designed to alleviate idea bankruptcy are the core of idea processing systems. They are designed to assist with the planning or invention phase of writing. There are two types of planning software, one which assists in forming concepts and the other which assists in forming relations among previously established concepts.

Many of the inventor devices are genre specific. The Planner that is part of the QUILL system is typical of this type. The Planner provides prompts to help the writer include information relevant to a particular type of writing task. Rubin

and Bruce (1984) give an example of the queries provided for a book review: What is the name of the book? Who is the author? What type of book is it? Who are the main characters? What is the major conflict? What was your principal feeling about the book? What is the main idea of the review? Note that the prompts do not actually provide assistance in generating actual content; rather, they provide guides as to the kinds of content that should be included.

A more sophisticated system designed for adults is called INVENT and was developed by Burns (1984). It includes three different types of planning programs, based on three different heuristics frequently discussed in composition texts (e.g., Flower, 1985). TOPOI, designed to assist with persuasive writing, uses Aristotelian topics for developing a thesis (e.g., similarities and differences, cause and effect). TAGI, intended for informative writing, uses the tagmemic matrix of Young, Becker and Pike (1970) to explore a concept from three perspectives: as a particle (static), as a wave (dynamic), and as a field (as part of a larger network). Finally, BURKE assists with informative writing by using a pentad of questions focusing on the scene, act, agent, purpose, and agency. This program could be particularly valuable in job settings which require frequent reports. Providing the writer with a set of questions that guides the development of the hierarchical structure of a document would help ensure that it includes the necessary information without unnecessary detail. Other types of planning software ask the writer to identify the key problems or to state the purpose of the paper, its intended audience, and its main ideas (e.g., WANDAH).

Planning software which assists in the formation of relations among already generated concepts uses both network and hierarchical models. For example, Smith's (1982) network program displays all possible pairs of ideas and asks whether they are related; if yes, the writer is asked to specify the nature of the relation. The program assists in stating the relation by providing such prompts as "is an explanation of", "is analogous to", etc. A similar program helps the writer find hierarchical relations among concepts and represents the ideas in a hierarchical tree structure. Such programs help a writer make the connections among ideas explicit, an aid that would be helpful for writers who expect too much inferential reasoning on the part of their audience.

Kellogg (1986) also considers problems attributable to affect, indicating that many writers experience anxiety or blocking when they attempt to write. This is a very real problem for many adult writers (cf., Rose, 1980), one which psychologists have addressed using behavioral therapy (e.g., Rosenberg & Lah, 1982). The INVENT software of Burns is perhaps the only idea processor that includes management of affect within the package itself. For example, as a writer responds to a query, the computer responds with such terms as good, fine, terrific. It

includes such phrases as "Relax now."; "We'll have fun..." etc. Whether such responses do in fact alleviate anxiety remains an empirical question. Positive reinforcement in the absence of a response worth reinforcing may have little if any effect, especially to an adult who knows very well that his or her response was not good, fine, or terrific.

According to Kellogg, the only study evaluating the impact of idea processors was conducted by Burns. Burns compared three experimental groups, each of which used a different one of his Invent programs, with a control group of students who heard a lecture on creativity. Burns compared the students on their idea generation before writing and on a detailed outline for the composition. All three experimental groups were superior to the control group in terms of both quantity and quality of ideas generated, but the outlines did not differ among the groups. Thus, the benefits to idea generation did not seem to carry over to the composition plan, but it is not clear whether this also means that completed compositions would be similarly unaffected. The students' responses to the programs were uniformly favorable, consistent with the attitude surveys of other aspects of computer-assisted writing.

Finally, Kellogg makes the important point that idea processors are based only on conjectures about what heuristics are likely to assist in idea generation. In other words, there is no empirical research showing that one particular invention heuristic is better than another, or even that they are an improvement over what a writer might normally do. Moreover, he cautions that not every type of idea processor is appropriate for every writing task, and individuals may differ in their ability to use them. Quite clearly, additional evaluation research is needed on the value of idea processors in writing improvement. Nevertheless, they do seem to offer promise to writers in generating and organizing ideas. Moreover, students who learn to use the heuristics in the software could also go on to use similar heuristics on their own. Thus, they would not need to rely on the availability of a computer to put their new knowledge to use.

In closing, it should also be noted that there are growing numbers of software packages designed specifically for writing instruction. Many of these are of the drill and practice variety and are probably of limited value in terms of enhancing higher-level cognitive processes associated with writing. However, they may be useful in terms of fostering automaticity of lower-level translation skills. There are also software programs which focus specifically on grammar and syntax. For example, one program is capable of generating and transforming sentences according to Chomsky's transformational rules. This allows the student to see the variety of ways that similar ideas can be expressed, and as Collins (1986) notes, it enables the student to think about language as a thing which can be manipulated to achieve different stylistic effects, an important metalinguistic

skill. Although these programs are primarily intended for children, they may also be useful for adult writers who rely exclusively on simple sentence structures. Such structures are not optimal for expressing complex logical relations and signaling differential importance of ideas.

In summary, it would appear that computer technology can play a vital role in instructional programs designed to enhance writing skills. Text editors promote increased refinement of one's ideas because of the ease of revision. Writer's aids provide feedback about the characteristics of one's texts at a fairly local level. However, a danger associated with writer's aids is that they may mislead students as to what really constitutes good writing. Electronic mail and publications systems provide opportunities for the receipt of feedback from peers. Idea processors assist in focusing attention and in idea generation and text structuring. It should be possible to design software that can be modified for different types of job-related writing. Thus, a planning device should be tailored to the specific kinds of writing activities that are needed on the job. Similarly, a writer's aid package should include checkers for document features that are essential for accomplishing specific rhetorical goals. Given the widespread acknowledgement that adult literacy instruction in the military and elsewhere should be based upon the kinds of real-life demands that the worker will face on the job (e.g., Mikulecky & Ehrlinger, 1986; Mikulecky & Strange, 1986), such adaptation would clearly be desirable.

Closing Comments

As noted at the outset, this paper was not intended to provide an exhaustive review of the literature on writing, nor was it intended to provide concrete guidelines for how ARI should implement its upcoming Literacy Skills project. Rather, the major intent was to provide an overview of issues relevant to the design of a program for improving officer and NCO literacy skills. The discussion of existing Army writing programs was limited primarily by the lack of readily available information. It was brought to my attention after I completed my work at ARI that the Army has a Communicative Arts Program that has resulted in required training in writing and speaking in officer basic and advanced courses. It is to be hoped that the officer program does put more emphasis on higher-level aspects of writing than the BSEP programs discussed here. The ARI research team will certainly need to examine this program in conjunction with their other efforts on this task.

It will also be necessary, as indicated earlier, to develop an adequate instrument to assess soldiers' writing competence, with particular attention to on-the-job demands. Careful documentation of actual writing demands will of course be a necessary prerequisite. Holistic measures of writing would probably be inappropriate, as are measures currently in use in the Army that focus on low-level, mechanical aspects of writing

competence. The focus should be on communicative effectiveness, that is, on how well the officer accomplishes his or her goals.

The bulk of the paper was devoted to a review of the literature on cognitive and metacognitive aspects of writing. It should be clear that psychologists have begun to make some important contributions and that interest in the field is growing rapidly. Substantial progress has been made in identifying the cognitive processes involved in writing, although this basic knowledge has yet to be widely translated into instructional practice. However, the increasingly popular conceptualization of writing as a problem solving process fits well with the learning strategies orientation of ARI and can provide the foundation for a direct instruction training approach.

The final section of the paper provided a brief description of some approaches involving computer technology that offer promise as a future direction for Army training programs. Development of instructional software is proceeding rapidly, and a number of colleges and universities now have computer-based writing laboratories. Time constraints precluded discussion of these laboratories, which have been described in detail in various writing journals, but they may be useful as models for designing training programs. However, to my knowledge, existing instructional technology for improving writing competence has not capitalized on the recent psychological research on cognitive and metacognitive aspects of writing. This is a step that ought to be taken and one that ARI would be well suited to undertake.

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