THE EFFECTS OF WRITING ABILITY AND MODE OF DISCOURSE ON COGNITIVE CAPACITY ENGAGEMENT

by

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PART I

The Evolution of Writing Process Models

Almost two decades have transpired since Rohman (1965) introduced his model of writing behaviors. Since that time it has been modified based on the findings by Emig (1971), Stallard (1976), Perl (1978), and Sommers (1978, 1979, 1980). Rohman's model and its subsequent modifications reflect the early trend of describing the writing process as a series of writing behaviors.

Rohman concluded that writers approach a writing task in three stages, the first of which is prewriting, the time when writers generate ideas that might be included in an essay. This stage is followed by the writing stage, when writers elaborate on these ideas, formalize them into complete thoughts, structure them into subordinating or coordinating relationships (often in the form of paragraphs), and become concerned with correct syntax and lexicon. In the final stage writers perform some "polishing up" activities to make the essay more appropriate for evaluation.

However, descriptive studies since Rohman (Emig, 1971; Flower & Hayes, 1980; Perl, 1978; Sommers, 1978, 1979, 1980;

Stallard, 1976) have provided additional insights into writing behaviors as they relate to writing ability and writing stages. Sommers (1978) states:

> [Rohman's model suggests] . . . a particular understanding of the composing process that is best described as a linear, uni-directional process capable of being divided into more or less discrete stages. These models that reverberate throughout the research better describe the written product than the process, because they identify stages of the product and not the operations of the process. (p. 209)

These later researchers have gone beyond Rohman's perceptions through observations, interviews, and protocol analyses. They have found, for example, that non-practiced student writers spend very little time prewriting (Emig, 1971; Perl, 1978; Stallard, 1974) and that rewriting generally results in editing, rather than text or meaning changes (Sommers, 1978, 1980). In addition to these discrepancies related to the activities writers engage in, Emig (1971) and Sommers (1978) have noted that prewriting and rewriting activities differ for good writers and basic writers. Good writers spend more time prewriting and rewriting and make more textual changes in the final drafts than do basic writers. The first drafts by basic writers tend to be their final drafts.

Emig (1971), Flower and Hayes (1980), Perl (1979), Sommers (1978, 1980), and Stallard (1974) have found also that writers do not perform one type of writing activity, such as prewriting, at one specific point and never engage in that activity again during the writing task. Writers, for example, often perform prewriting-related activities (content- or idea-generation) during the writing or rewriting stage when they sense that additional content is needed to expand or clarify their ideas. Perl (1979) states:

> This "back and forth" movement [appears] to be a recursive feature: at one moment students [are] writing, moving their discourse forward; at the next they [are] backtracking, rereading, and digesting what [has] been written. (p. 330)

At times though, certain activities occur inappropriately and actually interfere with the composing process. Sommers (1980), for example, has found that writers often engage in revision-related activities early in the writing task which interfere with the generation of relevant ideas for the paper. If writers are concerned with spelling and punctuation and sentence structure early, they are using up time and effort with matters that are not as necessary at that stage. Glynn, Britton, Muth, and Dogan (1982) have found that writers who attempt an initial draft

by generating ideas in the form of "polished" sentences produce less content than those who attempt an initial draft by generating unordered propositions, such as listing, that are not textually cohesive. According to Glynn, et al. (1982), "writers [are] able to allocate [more] of their capacity to the task of content production" (p. 565).

As modified, Rohman's model establishes a relatively descriptive framework of the activities writers undergo when they compose. Although the activities are recursive, there is a certain linear sense to composing. Writers, when first faced with a writing task, spend some time generating ideas and after some time end up with a "polished" product. We, in essence, can assume that writers predominantly engage in prewriting activities at a specific point in a writing task; the same is true for writing-related and rewriting-related activities. Although these activities can occur at any time, they are not the dominant activities at other specific points. In more current terms, writers are constantly faced with content and structure demands (Bracewell, Frederiksen, & Frederiksen, 1982; Bruce, Collins, Rubin, & Gentner, 1982).

The modifications to Rohman's model reflect writing behaviors as they have been observed by researchers and revealed by writers. A natural development of inquiry has

been an attempt to analyze the cognitive processes writers engage in when they compose. During the last decade, writing researchers (Flower & Hayes, 1981; Flower & Hayes, 1984; Glynn, et al., 1982; Stallard, 1976), going beyond analyzing writing behaviors, have attempted to investigate the cognitive processes involved when people write. The basic rationale behind this direction is simple: because writing involves processing information, the wealth of findings from cognitive studies may help to explain the cognitive activities related to writing.

Stallard (1976) briefly explains the operations, such as generating cues and activating searches of permanent memory, when writers are given a topic on which to write. From the topic statement, writers generate cues which activate searches of permanent memory for information that might be used in an essay. The cues prompt a central processor to retrieve information that appears to be related to the cues. According to Stallard (1976), as the text becomes more developed, writers impose some structure and "work" the words to accommodate such factors as audience and mode. Then during a final stage, they again access grammatical and lexical rules to complete or "polish up" the written product. Because of the rapid development of cognitive interpretations of writing processes, Stallard's

explanations appear, today, to be somewhat simplistic. His review, though, marked an important direction in writing research: the recognition of a link between writing and human memory.

In this vein, Flower and Hayes (1981) have developed a comprehensive, structural model, applying a well-known and widely accepted human memory model proposed by Atkinson and Shiffrin (1971) to writing processes. The Atkinson and Shiffrin model is based on the duplex theory, which depicts the memory system as having two major components (short-term memory and long-term memory). According to the Atkinson and Shiffrin model, environmental stimuli enter the memory system via sensory registers which store these stimuli very briefly. After certain stimuli are filtered, they then are processed on to working memory where several processes may take place. Often stimuli are used as cueing devices to activate searches of permanent memory for information related to the cues. At other times, elaborative rehearsal of stimuli is performed in order to pass the stimuli on to permanent memory where the stimuli become part of a person's knowledge base.

Flower and Hayes (1981), in applying the Atkinson and Shiffrin (1971) model to writing, present the topic and the expanding text as the environmental stimuli which are

temporarily stored in sensory registers (Klatzky, 1980; Sperling, 1960). Selected stimuli, such as the topic and the expanding text, are then processed on to working memory (also known as short-term memory). The stimuli then activate such processes as planning, organizing, goal setting, translating, reviewing, evaluating, and revising, depending on which process is appropriate at that particular time in the writing task (Flower & Hayes, 1981). Planning, for example, is when the writer forms "an internal representation of the knowledge that will be used in the writing" (p. 372). On the other hand, translating, a later process, is "essentially the process of putting ideas into visible language" (p. 373). These processes involve activating certain knowledge structures stored in long-term memory, or permanent memory. These structures include organized information on the topic at hand, the audience, and writing plans.

Despite the important insights gained from Flower and Hayes's writing model, it still is incomplete as an explanation of the processes writers experience. Although the model includes the structure of the memory system and the processes inherent to the structural components, it does not take into account the processing limitations of the memory system or the highly complex features of the organized information in permanent memory.

Processing Limitations

When processing information, human beings are faced with limited cognitive capacity, which restricts the amount of information that can be processed simultaneously (Broadbent, 1958; Kahneman, 1973; Kerr, 1973). These processing constraints center on storage (Atkinson & Shiffrin, 1971; Britton, Westbrook, & Holdredge, 1978; Craik & Lockhart, 1972; Miller, 1956) and effort (Johnston & Heinz, 1979). The composite of memory space and effort limitations is known as cognitive capacity (Broadbent, 1958). First, there is only so much memory space in working memory to store information that is being attended to. Thus, the information that is accessed for a particular task may often exceed, for various reasons, the amount of space that is allotted for processing (Miller, 1956). Also, there is a limited "pool of effort" (Johnston & Heinz, 1979) available for processing information stored in working memory. Flower (1979) in a review alludes to such limitations:

> [Working memory] is the active central processor of the mind; that is, it is the sum of all the information we can hold in conscious attention at one time. . . . Its limited capacity means that when faced with a complex problem--such as writing a college paper--we can hold and compare only a few alternative relationships in mind at once. . . .

> Trying to evaluate, elaborate, and relate all that we know on a given topic can easily overload the capacity of our working memory. (p. 31)

Again, despite the important, intuitive connection between writing and the memory system made by Flower (1979), her contention is speculative, rather than based on experimental data. Glynn et al. (1982) have taken two important steps. First, they look experimentally at the effect of information-processing limitations on writers of varying abilities. And, second, they focus on the task-related information writers access from permanent memory ("ideational fluency"). According to their study, average writers perform better when they use a listing strategy as an initial step than when they write a completely drafted essay. The strategy frees up space and decreases the demand on the effort available for processing. The performance of poorer writers, though, does not differ across treatments. Their explanation is that although listing frees up the capacity to process more information, cognitively facilitating strategies cannot remediate deficiencies in "ideational fluency" (p. 565). Their findings refer to factors such as experiences and ability that affect the status or condition of these units of information known as schemata (Klatzky, 1980).

The Effect of Schemata on Processing

Schemata are higher-order units of propositions that represent general knowledge or descriptions about some topic (Klatzky, 1980). Generically, a schema has three major characteristics. First, it has a "fill-in-the-blank kind of structure; the blanks are filled in when the schema is instantiated" (Klatzky, 1980; p. 212). The "structure appears to be retained independently of the specific characters or actions that fill in that structure, so it can be applied to new characters and actions" (Klatzky, 1980; p. 216; Fiske & Linville, 1980). Flower and Hayes (1984) state that "what people store in memory are meaningful gists rather than actual text" (p. 147). Secondly, by being a stereotyped description, it provides for typical events that occur (Klatzky, 1980). Schemata are "organizations built for efficiency, not accuracy" (Flower & Hayes, 1984, pp. 139-140). And third, it is depicted as having a hierarchy of components. These components are initially very general (e.g., an essay) which serve as frameworks for more specific information (e.g., descriptive writing, narrative writing, persuasive writing) which can be further broken down until a final level of specificity is attained (Flower & Hayes, 1984; Klatzky, 1980).

In writing, schemata containing information necessary to write a descriptive essay differ from schemata for writing a persuasive essay (Flower & Hayes, 1984). There also exist knowledge structures that include sets of rules, such as those governing language (Daiute, 1984; Rumelhart, 1975; Thorndyke, 1977). According to Daiute (1984), writers form sentences in a clause-by-clause sequence; "sentences are produced via a set of memorized patterns that do not have to be reconstructed for each utterance because they represent the major surface structure forms of English" (p. 207). "[Writers] store a variety of complex sentence structures in long-term memory. These structures . . . serve as patterns that guide the production of novel sentences" (Daiute, 1984, p. 210; Carroll, 1976, 1979; Carroll & Tanenhaus, 1978). When a task is given, people access schemata related to that task. The degree of development of the schemata will affect the performance of that task, not only in quality but also in the amount of effort needed. A task that has been performed numerous times should be of better quality because of the acquisition of more information and should require less effort because the schemata related to that task have been refined as a result of practice.

The Condition of Existing Schemata

Visually schemata can be depicted as a network of information with varying levels of information. The information at each level reflects the substance and condition of the information (Klatzky, 1980; Rumelhart, 1975). If, for example, a writer has had few experiences writing a certain mode or a certain type of sentence structure, when he or she attempts the less practiced mode or structure, the performance will not be as good or as quick. Regardless of the deficiencies, when a task demands certain schemata (mode, writing strategies, rules of language), they will be accessed at their current level of development (Flower & Hayes, 1984).

A current level may not indicate the potential, final level of a schema but simply indicate the level for that writer at that time (Flower & Hayes, 1984; Rumelhart & Ortony, 1977). Likewise, going from one level to another does not mean that higher levels have been developed or refined to their fullest potential (Klatzky, 1980). Thus, discrepancies at any level for a given writer may exist and affect performance quality. In essence, the more information and the degree of development of that information which a writer has on a particular type of writing task, on strategies for that task, and on rules of

language, the better he or she should perform that task (Flower & Hayes, 1984).

The Effect of the Condition of Schemata on Processing

During a writing task, the schemata that are accessed affect the amount of cognitive capacity engagement needed to process them. If the task is new or unpracticed, the schemata are in the early stages of development. Schemata are developed as they are practiced more and more. After human beings perform a particular task numerous times, the schemata "are restructured or replaced with more efficient and powerful units" (Wildman & Burton, 1981, p. 7). According to Norman (1978), when people are attaining knowledge, or building schemata, they "alternate [the processes of] . . . adding new information and restructuring . . . with 'tuning' activities . . . as the [schemata] begin to stabilize" (Wildman & Burton, 1981, p. 7). Once a building stage is complete, the space and effort needed to process them decrease.

The notion of schemata is also related to the phenomena of chunking and automaticity (Flower & Hayes, 1984; Neisser, 1975; Rumelhart & Ortony, 1977). Chunking refers to grouping related words or ideas and processing them as one unit (Miller, 1956). Depending on the task and the person's proficiency at that task, a chunk may include anything

ranging from a single letter to a cluster of related sentences (Klatzky, 1980). In fact, tasks that have been performed numerous times often become automatic because the schemata related to that task have become so refined that the processing of them becomes automatic (Hasher & Zacks, 1979).

In perhaps the most idealistic situation, a schema could be so refined that processing it would require relatively little engagement. If the schemata are not so well refined, the information cannot be chunked and will require relatively more capacity for processing. The fact that a schema may be extremely refined, however, does not mean that the refined information is of quality or complexity (Flower & Hayes, 1984; Klatzky, 1980).

The Semantic Nature of Schemata

Another dimension to the processing of schemata is the semantic nature of the information. Based on studies (Bever, 1973; Fodor & Bever, 1965; Garrett, Bever, & Fodor, 1966), reading passages with longer clauses requires more engagement than those with shorter clauses. This increased engagement is not necessarily because of the additional number of words, but the deeper meaning that additional related words contribute to the complete idea. According to Craik and Lockhart (1972), the longer the processing, as

attributed to clause length, the more perceptual analyses that are performed on the information, thus contributing to the possibility of deeper semantic processing. Mere time, as attributed to number of words read, only allows the opportunity for semantic processing, which is determined by the semantic potential of the information (Baddeley, 1978), not an increased number of words to analyze. The deeper the processing, the more meaning that is extracted. The more meaning that is extracted, the deeper the engagement.

Although in writing we are not only dealing with encoding but also with retrieval and production of information, the same inferences can be made. The longer the clauses, the higher the degree of relatedness. Because more information is being given, the degree of relatedness increases. As levels of processing theorists claim, the depth of processing--thus, engagement--depends on the nature of the information that allows it to be processed at a deeper, semantic level, not the number of units within that information (Baddeley, 1978; Craik & Lockhart, 1972).

In summary, writers are faced with the constraints of cognitive capacity which include limited mental space (Kahneman, 1973; Kerr, 1973) and energy (Johnston & Heinz, 1979). Because human beings are always working with a limited information-processing capacity (Broadbent, 1958),

they can process only a few units of information simultaneously. According to Neisser (1975), as schemata become more refined, the use of them requires less and less effort, regardless of the level of skill involved. A writer's existing command of the information and strategies related to the task will affect the amount of cognitive capacity engagement required for that task. The more refined and related the information is for that given task, the more successful the writer will be in chunking related information, thus requiring less cognitive capacity for processing.

Perspectives of Cognitive Capacity

The Development of the Concept

The notion of cognitive capacity began with Broadbent's filter theory (1958). He believed that we choose a certain stimulus for processing and, in doing so, filter out those that are not chosen. This interpretation is often known as the bottleneck theory. Once one channel of information is chosen, others are not able to pass through. This filter, or bottleneck, model proposes that selective attention acts like a filter, blocking out some channels and letting only one through. Prior to the process of filtering, incoming messages in all channels are analyzed on the basis of their

physical characteristics. The problem in his model, though, is the total elimination of all unchosen messages. The question that has come out of his paradigm is, if an incoming message is selected and all others cannot be attended to until the chosen message is completely dealt with, why are we able to move our attention from one message to another?

Triesman (1960,1964) posited this question in her studies on dichotic listening. In these studies, participants repeated aloud a message that was entering the right ear. When the message was then switched to the left ear, the participants continued to repeat the message, even though the channel changed. This finding proposes that more than one incoming message can be analyzed for meaning and that, in fact, the choosing of one message--and thus one channel--does not mean that all others are eliminated. They simply receive less attention and analysis. If this finding is true, then two major points of Broadbent's filter theory have been challenged: (1) the choosing of one channel does not completely block off other channels; and (2) an analysis beyond the physical characteristics is taking place.

In modifying Broadbent's filter theory, Triesman (1964) proposed that attention acts more as an attenuator by turning down the volume of unattended channels without

blocking them. According to Triesman (1964), all incoming signals are analyzed not only for physical characteristics but also for meaning. After such analyses, attention is then directed to one of the channels. This interpretation helps to explain how, in dichotic listening experiments, the participant can quickly switch to another channel which contains the continuation of the message attended to in the other channel.

But, there is one major problem with Triesman's model. If preliminary tests involve a somewhat complete analysis of incoming messages for meaning, then we are assuming that a message that has already been analyzed for its meaning has not yet been attended to. If this is the case, then there is nothing left for the person to do once a message is chosen for attention. While Broadbent's model locates the filter very early in the human memory system--directly after the sensory registers--Triesman's model locates it somewhere in working memory, and only after it has been matched with information in permanent memory for meaning. This filtering process actually becomes a subprocess in working memory (Klatzky, 1980; Norman, 1969).

Norman (1969) has proposed a model in which all channels receive some analysis, enough to activate a representation in permanent memory. It is at that point

that attention takes effect, corresponding to full recognition of the patterns in just one channel. Patterns in competing channels do not receive attention and are eliminated for further processing. So, according to Norman (1969), recognizing a pattern corresponds to attending to it. The Norman model attempts to compromise the discrepancies between the Broadbent model and the Triesman model by putting the bottleneck neither too early--all incoming channels receive a sensory or physical analysis and thus activate codes in permanent memory--or too late--only recognized messages are analyzed for full meaning. In current cognitive capacity research, Norman's model is the one that is accepted. Despite the different theories, the accepted notion is that we have a limited capacity when we attend to information.

The Measurement of Cognitive Capacity

To investigate the amount of cognitive capacity required for certain tasks, recent investigators have used a primary task/secondary task paradigm. In this design, researchers have based their interpretations on the amount of time participants take to react to a secondary task while performing a primary task (Posner & Boies, 1971). They have inferred that the amount of time it takes a participant to

react to a secondary task--usually a sound or a light--gives some indication of the amount of cognitive capacity required for the primary task: the longer the reaction time, the more cognitive capacity required for the primary task. This contention is congruent with the limited "pool of effort" (Johnston & Heinz, 1979) available for tasks involving human memory. If we are working with a limited "pool of effort" and a certain amount is required for one task, there is only so much left for other tasks. The more deeply we are engaged in a task, the more cognitive capacity is required; thus, smaller amounts of capacity are available for processing other information. The issue that is often investigated in cognitive capacity studies is how much capacity is required for certain types of tasks.

Capacity studies, for example, have controlled for certain variables, such as titles versus no titles (Britton, Holdredge, Curry, & Westbrook, 1979), differing levels of textual difficulty (Britton, Westbrook, & Holdredge, 1978), and rote memorization versus comprehension (Burton & Niles, 1982). A writing study measuring the capacity required for writing processes must control for factors that affect the final-written product.

Factors Affecting Final-Written Product

In addition to writing ability and experiences, variables that have affected final-product syntactic complexity and quality are topic (Langer, 1984; Strickland, 1962) audience (Crowhurst & Piche, 1979; Rubin & Piche, 1979), mode of discourse (Britton, Burgess, Martin, McLeod, & Rosen, 1975; Crowhurst & Piche, 1979; Rubin & Piche, 1979), and approaching a writing task in stages (Glynn, *et al*., 1982). According to Langer (1984) and Strickland (1962), the writing topic affects the quality and the syntactic complexity of the writing because the more familiar a writing topic is to the writers, the more easily they can generate content and have command of that content.

According to Crowhurst and Piche (1979) and Rubin and Piche (1979), audience (the person or persons a writer is writing the essay for) affects final-product syntactic complexity. When writers choose a close friend as the audience for their papers, the language tends to be in a familiar form, resulting often in the omission of content. Not only do they have experiential commonalities, but also they have communicated often so that the writer can omit information, assuming that the friend can fill in that information. At the other extreme is a formal adult. When writing for this type of audience, writers often write

clearly and formally but leave out much personal content. Teachers or parents, in positions of judging or evaluating, often fit into this formal adult category. The audience that results in the greatest syntactic complexity is trusted adult. This audience is usually a person who is older than the writer, much like the formal adult audience, but who is also trusted, much like the close friend. Not only does this audience allow for the writer to be clear and specific, but it also allows for the inclusion of much personal content.

Another major factor is mode of discourse. According to Britton, et al., (1975), Crowhurst and Piche (1979), and Rubin and Piche (1979), persuasive writing results in greater syntactic complexity than does narrative writing which results in greater syntactic complexity than descriptive writing. Persuasive writing involves presenting content in such a way that the audience changes its mind or opinion about the topic of the essay. Narrative writing, on the other hand, is a straightforward exposition of something that has occurred or an explanation. There is no real attempt to change the reader's mind or opinion. And, descriptive writing relies much on distinct, visual images. The purpose here is not to convince or recount but rather to picture.

Approaching a writing task in stages is yet another variable. According to Glynn, et al. (1982), writers who approach a writing task in stages write better essays than those attempting a final draft when first starting a writing task. Also, approaching a writing task in stages helps writers work within the limitations of the human memory system (Flower, 1979).

Summary and Research Questions

The purpose of this study was to determine the effects of mode of discourse and writing ability on cognitive capacity. Based on the literature, the amount of cognitive capacity engagement is determined by the developmental condition and the semantic nature of the schemata that are accessed for a particular task. Because writers of varying abilities approach writing differently and have had different experiences with certain types of writing tasks, writing ability was chosen as an independent variable. Because the different modes activate different schemata, mode of discourse was also an independent variable. And, stages of a writing task (prewriting, writing, and rewriting) was a third independent variable. Because writers engage in different activities when prewriting (content-generation) than when writing (elaborating and

organizing this content) and rewriting (formalizing this content), different degrees of cognitive capacity engagement may occur from one stage to the next.

The first three research questions were, therefore,

(1) Were there differences in cognitive capacity engagement across the three stages of the composing process?

(2) What was the effect of mode of discourse on cognitive capacity engagement? and

(3) What was the effect of writing ability on cognitive capacity engagement?

Because engagement times may not indicate the quality and complexity of the processing of the schemata, two other questions were asked:

(4) What is the relationship between engagement and the syntactic complexity? and

(5) What is the relationship between engagement and the quality?

REFERENCES

Atkinson, R. C. & Shiffrin, R. M. (1971). The control of short-term memory. Scientific American, 225, 82-90.

Baddeley, A. D. (1978). The trouble with levels: A reexamination of Craik and Lockhart's framework for memory research. Psychological Review, 85, 139-152.

Bever, T. G. (1973). Serial position and response biases do not account for the effect of syntactic structure on the location of brief noises during sentences. Journal of Linguistic Research, 2, 287-288.

Bracewell, R. J., Frederiksen, C. H., & Frederiksen, J. D. (1982). Cognitive processes in composing and comprehending. Educational Psychologist, 17(3), 146-164.

Britton, B. K., Westbrook, R. D., & Holdredge, T. S. (1978). Reading and cognitive capacity usage: Effects of text difficulty. Journal of Experimental Psychology: Human Learning and Memory, 4, 582-591.

Britton, B. K., Holdredge, T.S., Curry, C., & Westbrook, R. D. (1979). Use of cognitive capacity in reading identical texts with different amounts of discourse level meaning. Journal of Experimental Psychology, 5(3), 262-170.

Britton, B. K., Glynn, S., Meyer, B. J. F., & Penland, M. J. (1982). Effects of text structure on use of cognitive capacity during reading. Journal of Educational Psychology, 73, 57-64.

Britton, J., Burgess, T., Martin, N., McLeod, A., & Rosen, H. (1975). The development of writing ability (11-18). London: MacMillan Education.

Broadbent, D. E. (1958). Perception and communication. London: Pergamon Press.

Bruce, B., Collins, A., Rubin, A. D., & Gentner, D. (1982). Three perspectives on writing. Educational Psychologist, 17(3), 131-145.

Burton, J. K. & Niles, J. A. (1982). Cognitive capacity usage during prose processing. Blacksburg, VA: College of Education, Virginia Tech. (ED 224 818).

Carroll, J. M. (1979) "Mere length" and sentence comprehension units: A argument from ambiguity bias. Papers in Linguistics, 12.

Carroll, J. M. & Tanenhaus, M. (1978). Functional clauses and sentence segmentation. Journal of Speech and Hearing Research, 21, 793-808.

Craik, F. I. M. & Lockhart, R. S. (1972). Levels of processing: A framework for memory research. Journal of Verbal Learning and Verbal Behavior, 11, 671-684.

Crowhurst, M. & Piche, G. L. (1979). Audience and mode of discourse effects on syntactic complexity. Research in the Teaching of English, 13, 101-109.

Daiute, C. A. (1984). Performance limitations on writers. In R. Beach & L. S. Bridwell (Eds.), New directions in composition research. New York: The Guilford Press, 205-224.

Emig, J. (1971). The composing processes of twelfth graders. Urbana, IL: National Council of Teachers of English.

Fiske, S. T. & Linville, P. W. (1980). What does the schema concept buy us? Personality and Social Psychology Bulletin, 6, 543-557.

Flower, L. (1979). Writer-based prose: A cognitive basis for problems in writing. College English, 41, 19-37.

Flower, L. & Hayes, J. R. (1980). The dynamics of composing: Making plans and juggling constraints. In L. W. Gregg & E. R. Steinberg (Eds.), Cognitive processes in writing, (pp. 31-50). Hillsdale, N. J.: Erlbaum.

Flower, L. & Hayes, J. R. (1981). Plans that guide the composing process. In C. H. Frederiksen, M. G. Whiteman, & J. F. Dominic (Eds.), Writing: The nature, development, and teaching of written communication (Vol. 2). Hillsdale, N. J.: Erlbaum.

Flower, L. (1984). Images, plans, and prose: The representation of meaning in writing. Written Communication, 1, 120-160.

Fodor, J. A. & Bever, T. G. The psychological reality of linguistic segments. Journal of Verbal Learning and Verbal Behavior, 4, 414-420.

Garrett, M. F., Bever, T. G., & Fodor, J. A. (1966). The active use of grammar in speech perception. Perception and Psychophysics, 1, 30-32.

Glynn, S. M., Britton, B. K., Muth, D. K., & Dogan, N. (1982). Writing and revising persuasive documents: Cognitive demands. Journal of Educational Psychology, 74, 557-567.

Hasher, L. & Zacks, R. T. (1979). Automatic and effortful processes in memory. Journal of Experimental Psychology: General, 3, 356-388.

Johnston, W. A. & Heinz, S. P. (1978). Flexibility and capacity demands of attention. Journal of Experimental Psychology: General, 4, 420-435.

Kahneman, D. (1973). Attention and effort. Englewood-Cliffs, N. J.: Prentice-Hall.

Kerr, B. (1973). Processing demands during mental operations. Memory and Cognition, 1, 401-412.

Klatzky, R. (1980). Human memory: Structures and processes (2nd ed.). San Francisco: W. H. Freeman and Company.

Langer, J. A. (1984). The effects of available information on responses to school writing tasks. Research in the Teaching of English, 18, 27-44.

Miller, G. A. (1956). The magical number seven, plus or minus two: Some limitations on our capacity for processing information. Psychological Review, 63, 81-97.

Neisser, U. (1967). Cognitive psychology. New York: Appleton-Century-Crofts.

Norman, D. A. (1969). Memory and attention. New York: Wiley.

Norman, D. A. (1978). Notes toward a theory of complex learning. In A. M. Lesgold, J. W. Pellegrino, S. D. Fokkema, & R. Glaser (Eds.), Cognitive psychology and instruction. New York: Plenum Press.

Perl, S. (1979). The composing processes of unskilled writers. Research in the Teaching of English, 13, 317-336.

Posner, M. I. & Boies, S. J. (1971). Components of attention. Psychological Review, 78, 391-408.

Rubin, D. L. & Piche, G. L. (1979). Development in syntactic and strategic aspects of audience adaptation shown in written persuasive communication. Research in the Teaching of English, 13, 293-316.

Rumelhart, D. E. (1975). Notes on a schema for stories. In D. G. Bobrow & A. M. Collins (Eds.), Representation and Understanding. New York: Academic Press.

Rumelhart, D. E. & Ortony, A. (1977). The representation of knowledge in memory. In R. C. Anderson, R. J. Spiro, and W. E. Montague (Eds.), Schooling and the Acquisition pf Knowledge. Hillsdale, N. J.: Erlbaum.

Stallard, C. K. (1974). An analysis of the writing behavior of good student writers. Research in the Teaching of English, 8, 206-218.

Stallard, C. K. (1976). Composing: A cognitive process theory. College Composition and Communication, 27, 181-184.

Strickland, R. (1962). The language of elementary school children. Indiana University School of Education Bulletin, 38, 1-131.

Triesman, A. M. (1960). Contextual cues in selective listening. Quarterly Journal of Experimental Psychology, 12, 242-248.

Triesman, A. M. (1964). Verbal cues, language and meaning in selective attention. American Journal of Psychology, 77, 206-219.

Thorndyke, P. W. (1977). Cognitive structures in comprehension and memory of narrative discourse. Cognitive Psychology, 9, 77-110.

Wildman, T. M. & Burton, J. K. (1981). Integrating learning theory with instructional design. Journal of Instructional Development, 4, 5-14.

PART II

Abstract

The effects of writing ability and mode of discourse on cognitive capacity engagement across the three stages of the composing process were investigated. Sixty-three college freshmen of varying writing abilities (basic, average, and honors) were randomly assigned to experimental treatments (descriptive writing, narrative writing, and persuasive writing). Using the secondary task method, it was found that writing ability differentially affects cognitive capacity engagement across modes. For example, honors writers were least engaged when writing descriptive essays but were most engaged when writing persuasive essays whereas average writers were most engaged when writing descriptive essays but were least engaged when writing narrative essays. Analytic quality scores and engagement were related and results were interpreted in the context of schema theory to estimate the learning potential of a given mode of discourse. Also, engagement and syntactic complexity measures were related. It was found that as words per clause increased, engagement also increased; whereas, as clauses per T-unit increased, engagement decreased.

When faced with any information-processing task, human beings can perform a limited number of activities simultaneously, depending on the tasks at hand and the development of the units of relevant information known as schemata (Klatzky, 1980; Rumelhart & Ortony, 1977) that are stored in permanent memory (Neisser, 1975). Writers, when attempting a writing task, are constantly faced with the limitations of storage (Atkinson & Shiffrin, 1971; Britton,

Westbrook, & Holdredge, 1978; Craik & Lockhart, 1972; Miller, 1956) and effort (Johnston & Heinz, 1979). The composite of these storage and effort limitations is known as cognitive capacity (Broadbent, 1958). As tasks become more practiced, less capacity is needed (Neisser, 1975) because the accessed schemata are becoming more refined (Norman, 1978), allowing the information to be "chunked" and processed simultaneously, thus requiring less memory space and effort (Britton, Glynn, Meyer, & Penland, 1982).

Researchers investigating the amount of cognitive capacity engagement required for certain information-processing tasks have used the primary task/secondary task paradigm (Britton, Holdredge, Curry, & Westbrook, 1979; Posner & Boies, 1971). The assumption underlying this methodology is that as research participants are performing a primary task, the amount of time it takes them to respond to a secondary task (usually a tone or a light, depending on the type of primary task) indicates the amount of engagement required for the primary task (Britton, Westbrook, & Holdredge, 1978; Burton & Niles, 1982; Posner & Boies, 1971).

When placed within the context of schema theory, if the task-relevant schemata--units of organized information--are well developed, they can serve as powerful organizing

structures that not only guide activity but increase the amount of information available at one time (Rumelhart, 1975; Thorndyke, 1977). As these schemata become more refined (Neisser, 1975), the processing of them becomes more automatic and uses less capacity. If less capacity is being used, then there should be more processing capacity available with which to respond to the secondary task and the reaction time should be quicker. The relationship between engagement and the status of schemata is assumed to be non-linear (Britton, Westbrook, & Holdredge, 1978); tasks intermediate in difficulty require more capacity than tasks designated as being easy or difficult. Interpreted within the context of schema theory, a task is easy because the accessed schemata are well refined and the processing of them is approaching automaticity (Hasher & Zacks, 1979), leaving even more capacity to process other tasks. Or, the task is difficult because the related schemata are poorly developed and often are not retrieved and processed simultaneously, which leaves capacity to process other tasks (Neisser, 1975).

The Schemata of Writing

Schemata have a "fill-in-the-blank kind of structure; the blanks are filled in when the schema is instantiated" (Klatzky, 1980, p. 212). The "structure appears to be retained independently of the specific characters or actions that fill in that structure, so it can be applied to new characters and actions" (Klatzky, 1980, p. 216; Fiske & Linville, 1980). According to Flower and Hayes (1984), "what people store are meaningful gists rather than actual text" (p. 147).

People have different schemata for different tasks, demands, or experiences. Writers, for example, have schemata related to writing essays in narrative, descriptive, and persuasive modes (Flower & Hayes, 1984). Other studies (Rumelhart, 1975; Rumelhart & Ortony, 1977; Thorndyke, 1977) indicate that people store schemata that include sets of rules, such as rules that govern language. Daiute (1984), Carroll (1976, 1979), and Carroll and Tanenhaus (1978) found that writers "store a variety of complex sentence structures . . . [which] . . . serve as patterns that guide the production of novel sentences" (Daiute, 1984, p. 210). The more refined the sentence schema, the less capacity that is required to process it. "Depending on the relative stability of sentence-structure

patterns, writers are affected differentially by the limits of [cognitive] capacity" (Daiute, 1984, p. 208). According to Daiute (1984), inexperienced writers are affected by these performance limitations because they have to work consciously on all aspects of writing whereas experienced writers do not have to work as hard to form sentences and to think of what to say, thus decreasing the strain on working memory.

Schemata are also depicted as having a hierarchy of components, much like a network of propositions. There are levels of information which reflect superordinate, coordinate, or subordinate relationships among the units of information (Collins & Quillian, 1969). A current level may not indicate the potential, final development of the information for that level but may simply indicate the current development for that writer at that particular time (Flower & Hayes, 1984; Rumelhart & Ortony, 1977). Likewise, developing the next level does not mean that higher levels have been developed to their fullest potential. A level can easily be in a state of incompletion. To progress to another level, though, does not require the complete refinement of specifics at a higher level (Klatzky, 1980). In essence, the degree of development of the schemata that a writer has for a particular type of writing task (strategies

for approaching that task, rules of language and grammar, etc.), the better he or she should perform that task (Flower & Hayes, 1984). According to Britton, et al. (1982), Daiute (1984), and Neisser (1975), the status (poor development, good development, refinement) of the task-relevant schemata will affect cognitive capacity engagement requirements (memory space and effort).

Factors Affecting Writing Performance

Several factors affect the quality and syntactic complexity of final-written products: mode of discourse (Britton, Burgess, Martin, McLeod, & Rosen, 1975; Crowhurst & Piche, 1979; Rubin & Piche, 1979), audience (Crowhurst & Piche, 1979; Rubin & Piche, 1979), topic (Langer, 1984; Strickland, 1963), and approaching a writing task in stages (Glynn, Britton, Muth, & Dogan, 1982). It is assumed that writers have, stored in permanent memory, schemata related to these factors (Flower & Hayes, 1984), and the development of such schemata is related to writing ability (Daiute, 1984; Glynn, et al., 1982).

Studies (Flower & Hayes, 1984; Moffett & Wagner, 1983; Rockas, 1964) indicate that narrative writing is easier than descriptive writing which is easier than persuasive writing. A major reason for this task-difficulty continuum lies with

the nature of the mode. Narrative writing is a straightforward, chronological account of an event. Descriptive writing, on the other hand, relies on concise, distinct, visual images. And, persuasive writing involves presenting content in such a way that the members of the audience are to change their minds about the topic of the essay (D'Angelo, 1976). Also, according to Britton, et al. (1975), Crowhurst and Piche (1979), and Rubin and Piche (1979), persuasive writing results in greater syntactic complexity than narrative writing which results in greater syntactic complexity than descriptive writing.

In addition to the inherent nature of these modes, the status of the schemata related to a specific mode, or how proficient a writer is at that mode, would affect both quality and syntactic complexity. The status or proficiency would be a product of the writers' previous experiences and writing capability (Daiute, 1984; Glynn, et al., 1982). Flower and Hayes (1984), for example, state that a narrative schema is developed by age three.

Audience also affects the final-written product (Crowhurst & Piche, 1979; Rubin & Piche, 1979). When writers choose a close friend as the audience for their papers, the language tends to be in a familiar form, often resulting in the omission of content because of experiential

commonalities. At the other extreme is formal adult, a person in a position to evaluate and judge. Writers who choose this audience write clearly and formally but leave out much personal content. The audience that results in greatest syntactic complexity is trusted adult, a composite of close friend and formal adult. Not only does this audience allow the writer to be clear and specific, but it also allows for the inclusion of much personal content. Writers have, stored in permanent memory, schemata which guide their production of an essay that is being written for a specific audience (Flower & Hayes, 1981).

The topic is also a factor in that it must be something on which a person can write (Langer, 1984; Strickland, 1963). If a writer's topic-related schemata are not well developed or if he or she has very little information stored on that particular topic, his or her success will be different from those writers who have many well-developed, topic-related schemata. This success will be reflected by the quality and the syntactic complexity of the final-written product.

A final factor is approaching the writing task in stages. According to Flower (1979) and Glynn, et al. (1982), writers who break a writing task into stages perform better than those who do not because they are working around

the limitations of working memory. They are dealing with content and structure demands (Bracewell, Frederiksen, & Frederiksen, 1982; Bruce, Collins, Rubin, & Gentner, 1982; Flower 1979; Flower & Hayes, 1980, 1981) at more optimal times, thus lessening the demands on limited processing capacities.

Writing tasks involve accessing task-relevant schemata and processing these schemata within the limited information-processing capacity. The processing of selected schemata involves several factors. First, they are accessed at any point of their development (Klatzky, 1980). Second, because schemata relate to different tasks, they not only contain different amounts of information which affect organization but also the likelihood of processing them simultaneously (Britton, et al., 1982; Miller, 1956; Rumelhart, 1975). And third, practicing writing tasks develop and refine schemata for those tasks. Thus, those tasks require less capacity for processing (Neisser, 1975). In writing, task-relevant schemata include mode of discourse, audience, and topic, all of which are affected by ability and experiences (Daiute, 1984; Glynn, et al., 1982).

The major considerations of this study centered on the effects of writing ability and mode of discourse on cognitive capacity engagement. Also, because writers are

often concerned with specific activities when they are prewriting that differ from the activities when they write or rewrite, whether engagement during each of these three stages differed from one another was investigated. And because engagement results do not indicate the quality or the complexity of the processes, the relationships between syntactic complexity and engagement and between quality and engagement were determined. Specifically, the research questions were

(1) Are there differences in cognitive capacity engagement across the three stages of the composing process?

(2) What is the effect of writing ability on cognitive capacity engagement?

(3) What is the effect of mode of discourse on cognitive capacity engagement?

(4) What is the relationship between syntactic complexity and cognitive capacity engagement? and

(5) What is the relationship between quality of writing and cognitive capacity engagement?

Design of the Study

The three independent variables in this study were stages of the composing process (prewriting, writing, and

rewriting), writing ability level (basic, average, and honors), and mode of discourse (narrative, descriptive, and persuasive). The five dependent variables were reaction times (to measure cognitive capacity), quality scores (based on analytic scoring), and three measures of syntactic complexity (words per T-unit, words per clause, and clauses per T-unit).

Stages of the composing process were an independent variable for two reasons: first, to assure that all writers approached the writing task (primary task) similarly; and, second, to determine whether reaction times differed, based on the different processes the writers underwent as they prewrote, wrote, and rewrote. Mode of discourse was the type of essay each group was assigned: descriptive, narrative, or persuasive.

Writing ability level was based on the writers' placement in freshman English. There were three different writing ability levels. They were labeled basic writers, average writers, and honors writers. Basic writers were those that had been placed in freshman English based on the following criterion: an average of the SAT (Verbal), Test of Standard Written English, and English Composition Achievement Test scores between 340 and 399. Average writers were those that had been placed in freshman English

based on the following criterion: an average of the SAT (Verbal), Test of Standard Written English, and the English Composition Achievement Test scores between 400 and 579. Honors writers were those that had been placed in freshman English based on the following criterion: an average of SAT (Verbal), Test of Standard Written English, and English Composition Achievement Test scores between 580 and 609. In addition, each freshman English writer had written a placement essay to verify that placement.

Cognitive capacity, the first dependent variable, was determined by measuring the amount of time it took the writers to respond to a tone (a beep sounded by a microcomputer) while attempting the writing task. Quality scores were determined by the rating given each essay by the raters based on analytic scoring criteria. Syntactic complexity was determined by analyzing the final-written product on three T-unit measures.

Method

Subjects

Participants in the study were three groups of seven basic, three groups of seven average, and three groups of seven honors writers (n = 63) randomly selected by level from 135 volunteer, first-quarter, freshman composition students at Virginia Tech.

Instruments and Apparatus

A program was designed which caused a microcomputer to sound randomly a tone as each participant writer was engaged in the writing task. The writer, upon hearing the tone from his or her computer, pressed the space bar which was color coded in red. The computer program measured and recorded the time it took the writer to respond to the tone.

Syntactic complexity was measured by conducting T-unit analyses. A T-unit is an independent clause plus any related dependent clauses and embedded modifiers (Hunt, 1970). Hunt's T-unit analyses involves three measurements: words per T-unit, words per clause, and clauses per T-unit.

The quality scores were determined by three independent raters who underwent a training session, followed by a session to establish reliability. Inter-rater reliability was 1.0 prior to the actual evaluation of the essays. Each essay was read by two of the three raters who rated them by giving a score between one and four. The two scores were combined to establish a composite score, ranging from two to eight. If two scores on a particular essay were more than one point from one another, the third rater read the essay. The two matching scores were then combined. Of the 63 essays, 56 received initial scores from the two raters that were not more than one point from one another (r = 0.89).

The seven remaining essays were read by the third rater; five received a score that matched one of the two initial scores (r = 0.97). The matching scores were then combined for a composite score. I read the two remaining essays and combined the two matching scores.

Procedures

Each writer took part in a seven-minute warm-up exercise using the microcomputer to become acquainted with the computer system and task demands. After completing the brief exercise, the writers were then introduced to the topic, audience, and invention strategy to be used in the study. The topic for the narrative mode was "Give a chronological account of an event that involved drinking." The topic for the descriptive mode was "Describe a person and/or a place that was involved in drinking." And, the topic for the persuasive mode was to take a stand for or against the statement "The drinking age should be raised to 21." The audience for all groups was trusted adult. An invention strategy was devised to guide the research participants through the prewriting stage. Based on Burke's pentad/ratios (1945), the invention strategy was comprised of a list of questions, modified to accommodate the different modes.

After the training session, the writers were assigned to carrels which were arranged so that there was sufficient auditory distance between each microcomputer to prevent a writer from hearing the tone from another microcomputer. Each writer then began the writing task. The writing task was divided into three stages: prewriting, writing, and rewriting.

Tones were programmed to sound randomly five times during the 15-minute prewriting stage, ten times during the 30-minute writing stage, and five times during the 15-minute rewriting stage. The writers were informed two minutes before each writing stage was to end that they were approaching the end of that stage.

Analysis of the Data

A 3 (mode of discourse) X 3 (writing ability) X 3 (stages of the composing process) factorial analysis was run with repeated measures for the dependent variable reaction time. In addition, three multiple linear regressions were conducted with mode, level, and a composite reaction time based on the mean reaction times for the prewriting, writing, and rewriting stages as the independent variables. Each of the measures of syntactic complexity (words per T-unit, words per clause, and clauses per T-unit) were the

dependent variables in these regressions to establish the relationship between syntactic complexity and cognitive capacity, mode, and level. A multiple linear regression was run with mode, level, and a composite reaction time based on the reaction time means in each of the three stages as the independent variables. Analytic quality scores were the dependent variable in this regression to establish the relationship between quality of writing and cognitive capacity, mode, and level. According to Kirk (1968), when interactions are shown not to be statistically significant, the variance they are contributing should be pooled because it is by chance. The variance should be placed in the error term (within group mean square). Thus, for any interaction that was found not to be statistically significant, its variance was pooled.

Results

The Effects of Mode, Writing Level, and Stage on Cognitive Capacity

Although both mode of discourse (F (2,178) = 5.471, MSe = 0.056, p = 0.005) and writing ability (F (2,178) = 12.620, MSe = 0.056, p < 0.001) had statistically significant main effects on engagement, these effects were qualified by the presence of a two-way interaction between mode of discourse

and writing ability (F (4,178) = 7.664, MSe = 0.056, p < 0.001). No other effects or interactions were statistically significant.

As can be seen in Figure 1, most of the treatment effect differences, relative to other conditions, were accounted for by average writers writing descriptive essays (X = 1.11 sec.; see Table 1) and honors writers writing descriptive essays (X = 0.56 sec.). Thus, the sources of effect were the mean differences between average writers writing descriptive essays and honors writers writing descriptive essays versus other treatments.

Using the Newman-Keuls method of pairwise comparisons, I determined that mean engagement time for average writers writing descriptive essays differed from the means of all other treatment conditions. Likewise, with two exceptions, the treatment of honors writers writing descriptive essays differed from all treatments. Those exceptions were the cases of honors writers writing persuasive essays and basic writers writing narrative essays.

In this study, the two-way interaction between writing ability and mode of discourse indicated that writing ability differentially affected the amount of engagement required when attempting certain modes of discourse. Whereas average writers used the most engagement when writing descriptive

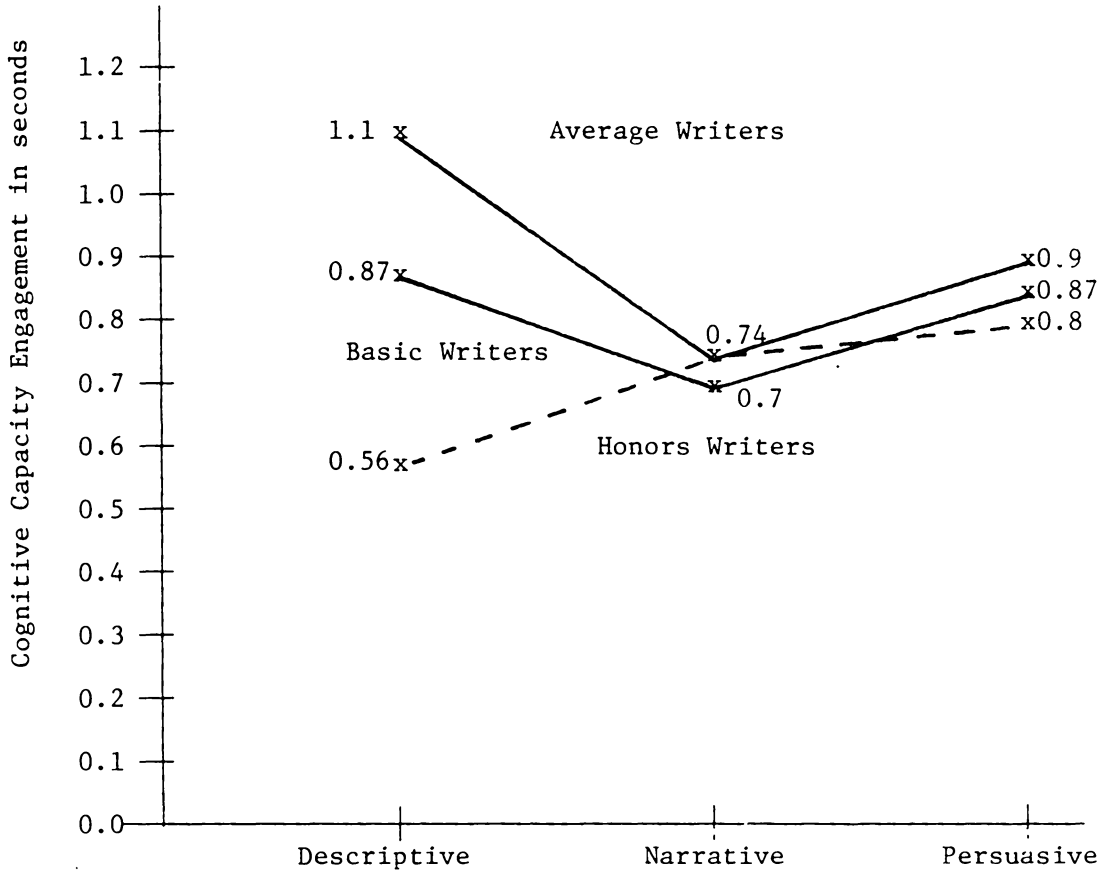


Figure 1. Relationships between cognitive capacity engagement, mode of discourse, and writing ability depicting a two-way interaction between mode of discourse and writing ability.

Table 1

The Effects of Writing Ability and Mode of Discourse (Descriptive, Narrative, and Persuasive Essays) on Cognitive Capacity Engagement (standard deviations are given in parentheses)

		Mode				
Writing Ability	n	Descriptive	Narative	Persuasive	n	Total
Basic Writers	21	0.866 sec. (0.143)	0.696 sec. (0.265)	0.866 sec. (0.153)	63	0.809 sec. (0.208)
Average Writers	21	1.107 sec. (0.247)	0.744 sec. (0.310)	0.896 sec. (0.237)	63	0.916 sec. (0.277)
Honors Writers	21	0.563 sec. (0.377)	0.739 sec. (0.230)	0.796 sec. (0.156)	63	0.700 sec. (0.284)
Total Writers	63	0.846 sec. (0.350)	0.726 sec. (0.267)	0.796 sec. (0.144)	189	0.808 sec. (0.272)

essays, honors writers used the least. The order from most engagement to least engagement for average writers was (1) descriptive (X = 1.11 sec.; see Table 1) and (2) persuasive (X = 0.90 sec.) and narrative (X = 0.74 sec.). The order for honors writers was (1) both persuasive (X = 0.80 sec.) and narrative (X = 0.74 sec.) and (2) descriptive (X = 0.56). There was no order for basic writers because there were no statistically significant pairwise comparisons among modes of discourse for basic writers (X-des = 0.87 sec.; X-nar = 0.70 sec.; and X-per = 0.87 sec.).

The Relationships Between Cognitive Capacity and Syntactic Complexity and Between Cognitive Capacity and Quality

Multiple linear regressions were conducted to determine the relationships between cognitive capacity engagement and syntactic complexity and between cognitive capacity engagement and quality. Because writing ability and mode of discourse had statistically significant main effects and a two-way interaction, they were included in the regressions.

Cognitive Capacity and Syntactic Complexity

There exist linear relationships between words per clause and engagement (F (3,59) = 2.957, SEb = 0.249, p = 0.005) and between clauses per T-unit and engagement (F (3,59) = 2.205, SEb = 0.096, p = 0.03). The nature of these

relationships, however, are opposite. The linear relationship between engagement and words per clause is positive, indicating that as more words per clause were generated, more capacity was required (see Table 2). Writing ability proved not to have a significant relationship with words per clause (F (3,59) = 1.391, SEb = 0.199, p = 0.17). Assuming the hierarchical notion of mode difficulty across all writers, the relationship between words per clause and mode of discourse was positive (F (3,59) = 2.703, SEb = 0.197, p = 0.009). Narrative writing (see Table 2) resulted in fewer words per clause (X = 8.05) than descriptive writing (X = 8.84) which resulted in fewer words per clause than persuasive writing (X = 9.96).

The relationship between clauses per T-unit and engagement (F (3,59) = 2.205, SEb = 0.096, p = 0.03) was negative; as the number of clauses per T-unit increased, less capacity was required. Both mode of discourse and writing ability were statistically significant: mode of discourse (F (3,59) = 5.092, SEb = 0.022, p < 0.001); writing ability (F (3,59) = 2.469, SEb = 0.022, p = 0.017). The relationship between mode of discourse and clauses per T-unit was positive whereas the relationship between writing ability and clauses per T-unit was negative. Basic writers wrote more clauses per T-unit (X = 1.61) than average

Table 2

Means and Standard Deviations (in parentheses) of Cognitive Capacity Engagement, A Composite of Cognitive Capacity Engagement, Words Per Clause, Clauses Per T-unit, and Analytic Quality Scores

			Mode				
Writing Ability	n	Descriptor	Descriptive	Narrative	Persuasive	n	Total
	21	Reaction Time-sec.	0.866(0.143)	0.696(0.265)	0.866(0.153)	63	0.809(0.208)
	7	RT-Composite	2.435(0.220)	2.087(0.623)	2.599(0.348)	21	2.374(0.464)
Basic	7	Words Per Clause	8.491(0.939)	8.223(1.301)	9.404(1.128)	21	8.706(1.193)
Writers	7	Clauses Per T-unit	1.497(0.110)	1.601(0.160)	1.731(0.149)	21	1.610(0.166)
	7	Analytic Quality	3.429(1.397)	5.714(1.704)	3.571(0.535)	21	4.238(1.640)
	21	Reaction Time-sec.	1.107(0.247)	0.744(0.310)	0.896(0.105)	63	0.916(0.277)
	7	RT-Composite	3.322(0.646)	2.232(0.311)	2.687(0.237)	21	2.747(0.617)
Average	7	Words Per Clause	9.679(1.341)	7.327(0.759)	10.226(0.964)	21	9.077(1.341)
Writers	7	Clauses Per T-unit	1.426(0.112)	1.631(0.263)	1.673(0.127)	21	1.577(0.204)
	7	Analytic Quality	6.143(2.035)	5.714(1.496)	5.000(1.155)	21	5.619(1.596)
	21	Reaction Time-sec.	0.563(0.377)	0.739(0.230)	0.796(0.156)	63	0.700(0.284)
	7	RT-Composite	1.690(1.027)	2.223(0.502)	2.389(0.385)	21	2.101(0.728)
Honors	7	Words Per Clause	8.343(1.253)	8.591(1.047)	10.246(1.315)	21	9.060(1.438)
Writers	7	Clauses Per T-unit	1.447(0.112)	1.489(0.152)	1.617(0.093)	21	1.518(0.137)
	7	Analytic Quality	5.957(1.215)	5.571(1.272)	6.143(1.345)	21	5.857(1.236)
	63	Reaction Time-sec.	0.846(0.350)	0.726(0.267)	0.853(0.144)	189	0.808(0.272)
	21	RT-Composite	2.482(0.961)	2.181(0.475)	2.558(0.338)	63	2.407(0.659)
Total	21	Words Per Clause	8.838(1.285)	8.047(1.143)	9.959(1.158)	63	8.948(1.418)
Writers	21	Clauses Per T-unit	1.457(0.110)	1.574(0.199)	1.674(0.128)	63	1.568(0.173)
	21	Analytic Quality	5.143(1.957)	5.667(1.426)	4.905(1.480)	63	5.238(1.643)

writers who wrote more clauses per T-unit (X = 1.577) than honors writers (X = 1.518). The better writers wrote fewer clauses per T-unit.

Cognitive Capacity and Quality

Not surprisingly, there was a statistically significant relationship between quality and writing ability; as writing ability increased so did quality (X-basic = 4.24; X-average = 5.62; and X-honors = 5.86; see Table 2). Simply put, the writers designated as the better writers *a priori* wrote better essays than those writers designated as the poorer writers. There was not a statistically significant relationship between quality and engagement.

Discussion

The Effect of Mode and Level on Cognitive Capacity Engagement

According to cognitive capacity studies (Britton, Westbrook, & Holdredge, 1978; Burton & Niles, 1982), a U-shaped curve results when writing task difficulty and cognitive capacity engagement are related. The general finding is that engagement increases as difficulty moves from an easy level to an intermediate level, but engagement then begins to decrease as the level moves from intermediate difficulty to extreme difficulty. Using this finding, I

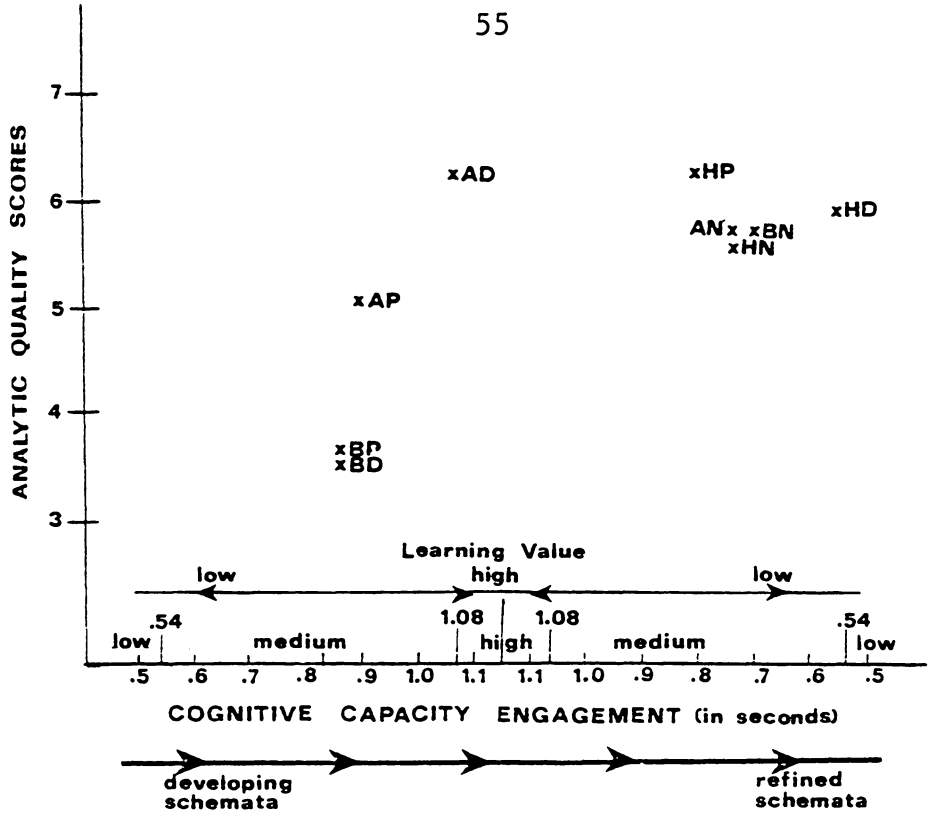
have made inferences about the degree of difficulty of each mode for each writing ability group. Although it is fairly easy to establish which tasks are of intermediate difficulty for any writing group, it is difficult to determine whether tasks are easy or difficult. Engagement across all groups supports the hierarchical notion of difficulty of writing tasks. However, when diverse groups are compared, low engagement can indicate that a task is easy because it uses less cognitive capacity, but low engagement can also indicate that a task is so difficult that a student cannot attend to it.

For basic writers, all modes are equal in difficulty because of the absence of statistically significant pairwise comparisons. For average writers descriptive writing is more intermediate in difficulty because engagement was low for both narrative and persuasive writing. Based on a U-shaped engagement paradigm, however, engagement alone cannot be used to determine whether narrative and persuasive writing are difficult or easy tasks for average writers. For honors writers both persuasive and narrative writing are more intermediate in difficulty than descriptive writing, which required less engagement. Again applying a U-shaped paradigm, engagement alone cannot be used to determine whether descriptive writing is a difficult or easy task.

In this study, cognitive capacity engagement and analytic quality scores were related (see Figure 2); the question posed is, given the amount of engagement, how successful were the writers at that particular task? The degree of success, via analytic quality scores when related to engagement results, helps determine the degree of difficulty, much like recall test scores in the cognitive capacity studies (Britton, Westbrook, & Holdredge, 1978; Britton, Holdredge, Curry, & Westbrook, 1979).

The relationship between engagement and quality might suggest the learning value of a given task (see Figure 2). Although both quality and engagement are assumed to be continuous (and, therefore, may be combined in an infinite number of ways), nine such relationships are possible within the categories established in this study. These nine relationships are low engagement/low quality; low engagement/medium quality; low engagement/high quality; medium engagement/low quality; medium engagement/medium quality; medium engagement/high quality; high engagement/low quality; high engagement/medium quality; high engagement/high quality.

An explanation of the four extreme relationships may be helpful in understanding the inferences that might be made. If both the engagement and quality for a given task, for



B = basic writer
A = average writer
H = honors writer

N = narrative essay
D = descriptive essay
P = persuasive essay

Figure 2. Relationships Between Analytic Quality Scores and Cognitive Capacity Engagement as Indicators of Status of Task-Relevant Schemata and Learning Potential of Narrative, Descriptive, and Persuasive Writing Tasks for Basic, Average, and Honors College Freshman Writers.

example, are low, it might mean that the task-relevant schemata are not well developed and, in fact, might even be non-existent. The learning value of a task resulting in such a relationship between engagement and quality might be considered to be low because the writers may not have schemata related to that particular task, indicating that much instruction may need to take place to begin the building of such schemata. If the engagement is high but the quality is low, this relationship might mean that the writers have schemata related to the task but the substance and development of the schemata are not of quality. The learning value of a task resulting in this type of relationship would be high because the writers are at the early stages of developing and building schemata related to that task. If both the quality of the performance and the engagement are high, perhaps the schemata are being "tuned"; despite the high quality, which reflects well-developed schemata, the processing of them requires much capacity, indicating a "tuning" process of some type (Norman, 1978). The learning value of a task resulting in this relationship would be high. Such writers are perhaps in either the later stages of developing or the early stages of refining their schemata. And finally, if the engagement is low but the quality is high, this relationship might mean that the task-

relevant schemata are well tuned and need relatively little capacity for processing, perhaps approaching a point of automaticity (Hasher & Zacks, 1978; Neisser, 1975). Thus, the relationship between engagement and quality may be a good indicator of the learning value of a task.

Difficulty of Mode by Level

Descriptive Writing and Writing Ability Levels

Descriptive essays written by average writers resulted not only in their highest engagement but also in their highest quality. Based on these results, the schemata that average writers have related to descriptive writing are well developed but not so well developed that the processing of them has reached a point of automaticity. Given more opportunities, the average writer should be expected to "tune" and refine the descriptive-related schemata, maintaining the quality with less engagement. Thus, the learning value of descriptive writing for average writers is still high.

Honors writers, on the other hand, were least engaged when writing descriptive essays but received equal quality scores. For the same quality performance, honors writers were engaged considerably less. This finding indicates that honors writers engaged in writing descriptive essays are

accessing schemata that are extremely well tuned and refined, perhaps to the point of automaticity. As supported by Neisser's notion (1975), the descriptive-related schemata of honors writers have been practiced to the point that less engagement is required.

Basic writers were less engaged than average writers but more engaged than honors writers. Their quality scores, however, were lower than those by either average writers or honors writers. This fact indicates that the schemata are not developed sufficiently so that successful chunking is possible. Thus, the schemata cannot be processed simultaneously or quickly. So, instead of having well-developed schemata, as the engagement might indicate--as tasks are more and more practiced, less engagement is required--this relationship between engagement and quality reflects developing schemata, rather than refined schemata.

For basic writers, the task of descriptive writing accesses schemata that are in a beginning, building, or developing stage. For average writers, it accesses schemata that are well developed but unrefined so that the processing of them requires high engagement. And for honors writers, it accesses refined schemata that can be processed easily. Descriptive writing, therefore, has good, potential learning value for basic writers, because the schemata are in the

early stages of development. For average writers, the learning value is high because the schemata are well developed but need refinement. The learning value for honors writers, however, is quite low because the schemata are refined.

Narrative Writing and Writing Ability Levels

The quality scores and engagement for narrative writing for all writing ability levels did not result in statistically significant mean differences. Schemata, regardless of writing ability, are well developed, perhaps to the point of automaticity. The narrative continuum would, thus, have all writing ability groups at the "easy" end.

Based on these relationships, it can be stated that the learning value of narrative writing is quite low for all writers. In fact, Flower and Hayes (1984) state that the narrative schema is developed by age three.

Persuasive Writing and Writing Ability Levels

Although persuasive writing resulted in statistically significant quality mean differences across ability, the engagement did not differ across the three writing ability levels. Based solely on engagement, this finding means that for all groups, persuasive writing requires the same amount

of engagement. But, the quality scores indicate the degree of development of persuasive-related schemata. Based on quality scores, basic writers' schemata are of poor quality and are not well developed. Although average writers were as engaged as basic writers, their persuasive-related schemata are of better quality and are somewhat more developed. And, for honors writers, equally engaged, the quality scores indicate that their persuasive-schemata are of very good quality and are within reach of becoming automatic.

For basic writers, persuasive writing has good, potential learning value, because the basic writer must build on or add to his or her existing persuasive-related schemata. For average writers, persuasive writing also has learning potential. Average writers, based on the relationship between engagement and quality, have both developed and developing schemata related to persuasive writing. Although honors writers appear to possess well-developed, refined, persuasive-related schemata, the learning value is still relatively high because, unlike descriptive writing which resulted in low engagement, the task required more engagement.

Why Engagement Did Not Differ Across Stages

Based on studies (Emig, 1971; Sommers, 1979), writers of varying abilities approach writing tasks differently. Compared to basic writers, good writers spend more time on their writing tasks and approach such tasks in steps. Based on these observations, it can be assumed that good writers not only have a variety of schemata related to approaching a writing task in stages but also have better developed schemata.

That approaching the writing task in stages did not prove to be statistically significant across writing ability groups can be explained in the context of schema theory. For good writers, the experimentally imposed structure related to prewriting may have taken away the effectiveness of the schemata that they had developed outside the context of this study, thus not allowing them to use their inherent schemata to guide them through the writing task. In fact, the presence of highly developed schemata likely interfered with their ability to use the experimentally required prewriting strategy by resulting in negative transfer (Osgood, 1949). With the assumption of a continuum for developing writing strategies across ability groups, average writers were neither hindered nor helped by the imposed three-stage approach. In addition, the fact that good

writers spend more time prewriting and rewriting relative to poor writers (who typically spend very little time at such tasks; Emig, 1971; Sommers, 1979) was negated because all the writers were required to spend equal time in such efforts.

The basic writers, however, were possibly aided by the experimentally imposed, three-step approach to the writing task. As indicated by Emig (1971) and Sommers (1979), basic writers tend to have poorly development schemata for prewriting and rewriting. Thus, when forced to approach a writing task in three steps, the imposed structure provided them with a strategy for approaching prewriting which was not a part of their writing repertoire. The experimentally imposed approach equalized the performance of both good and poor writers but for different reasons, helping the poor writers but interfering with the good writers.

The Relationship Between Syntactic Complexity and Engagement

Studies indicate that length of clause affects the amount of cognitive capacity engagement. Reading passages with longer clauses results in slower reaction times than those with shorter clauses (Bever, 1973; Fodor & Bever, 1965; Garrett, Bever, & Fodor, 1966). Intuitively, this increased engagement makes sense. More words, or more

informational units, are being processed, so increased engagement is needed to accommodate the additional units. Theorists, such as Craik and Lockhart (1972) and Baddeley (1978), however, have found that semantic processing depends on the nature of the information being processed. A four-word clause of unrelated words, for example, does not result in the same type of processing that a four-word clause of related words requires. The clause of related words allows the reader to elaborate on the meaning of the words as a semantic entity (Craik & Tulving, 1975). Thus, the number of words to process does not determine the type of processing, but rather the potential of elaboration, via the meaning inherent to the group of words.

In this study, there was a positive relationship between words per clause and engagement. Similar to the findings by Craik and Lockhart (1972) and Baddeley (1978), increased engagement may have been required because of the additional meaning that more words provided and the increased elaboration of the information needed to create that meaning. Because the participant writers created their own passages, meaningfulness on a holistic level was not guaranteed. For example, on the basis of analytic criteria, a four-word clause by a basic writer may not be as meaningful as one by a honors writer. But, meaningfulness

and the elaboration of information to create that meaning are writer-specific. What is a meaningful elaboration for a basic writer may differ from what is a meaningful elaboration for a honors writer. But nonetheless, elaboration of information to create meaning, regardless of how that meaningfulness stands in relation to the meaningfulness by other writers, depends on the writers themselves and should not be analyzed through criteria external to the writers creating that meaning.

At the other extreme of syntactic complexity are clauses per T-unit. There was a statistically significant, negative relationship between clauses per T-unit and engagement: as the number of clauses per T-unit increased, engagement decreased. This measurement designates the breaks between clauses, or cohesive units of related words. According to Britton, Westbrook, and Holdredge (1978), "when frequent breakdowns in . . . grammatical calculations [occur] . . . short-term memory and processing spaces are temporarily emptied. This leaves considerable processing capacity available for the secondary task, and fast reaction times are the result" (p. 578). Because writers, when going from the writing of one clause to another, experience such breaks in "grammatical calculations," the intervening moments represent the end of one cohesive unit and the beginning of another, thus interrupting engagement.

The negative relationship between clauses per T-unit and engagement is partly explained by the strength of the independent clauses. The lower the clause-per-T-unit ratio, the higher the percentage of independent clauses because a T-unit always has one independent clause. "Independent clauses are stronger perceptual units than dependent clauses, and thus more readily stimulate semantic recoding[:] . . . after perception or production of one clause, the exact words fade from short-term memory and the meaning of the clause is stored in long-term memory" (Daiute, 1984, p. 209). Thus, the higher the percentage of independent clauses--or the lower the ratio between clauses and T-units--the more semantic recoding and the increase in engagement.

The Relationship Between Quality and Engagement

There was not a statistically significant relationship between quality and engagement. This is partly explained by the positive, linear relationship between level and quality. Honors writers wrote better essays than average writers who wrote better than basic writers. However, average writers were more engaged than basic writers who were, in fact, more engaged than honors writers. In essence, it can be stated

that for honors writers the research writing tasks did not make as many cognitive demands as they did for basic writers or for average writers. The honors writers, because they had well-developed, almost refined, task-relevant schemata, performed well without having to be as engaged. Average writers and basic writers, because their task-relevant schemata were not as well developed, were not able to perform as well.

Because quality has been used to determine the status of task-relevant schemata, it is possible that any degree of engagement may result in either low or high quality. Honors writers, for example, were engaged the least when writing descriptive essays but their essays received high quality scores. Basic writers, on the other hand, were moderately engaged when writing descriptive, narrative, and persuasive essays, but the quality of their writing ranged from low to medium quality.

The Measurement of Writing Schemata

In this study, the determination of goodness of writing-related schemata was based on the relationship between engagement times and analytic quality scores. This relationship answered the question, given the amount of engagement, how successful were these writers at that

particular task? Engagement reflected the amount of cognitive capacity that was required to process the schemata, and quality reflected the substance of the schemata as measured by writing quality. As mentioned earlier, several relationships between engagement and quality are possible, and each relationship may be used to make inferences about the goodness of the schemata that were accessed.

There may be ways other than relating engagement and quality to measure to goodness of schemata. In cognitive research, for example, Thorndyke (1977) attempted to analyze the dimensions of a narrative schema by breaking a passage into four structural components: setting, theme, plot, and resolution (see Mayer, 1981, pp. 68-75, for a detailed explanation). He next isolated the sentences of the passage into individual propositions, or events. And then, he assigned each proposition to one of the four structural components, creating a network of propositions. Thorndyke was interested in determining whether humans tend to build structures, or impose some structure on the text they are processing. He found that those research participants that imposed structures that paralleled the inherent structure of the passage better recalled the details of the passage. He also was able to make inferences about the schemata the

participants accessed; those that provided greater detail in their recalls had accessed schemata of greater detail.

Perhaps in writing, a means other than relating engagement and quality would be to determine the structural components of certain modes of discourse, such as narrative writing, descriptive writing, and persuasive writing. Thorndyke's (1977) analysis of narrative discourse provides some direction on this process. A next step would then be determining the propositions of each essay and assigning these propositions to the appropriate structural components, creating a network of propositions. An evaluative step would then be needed to distinguish between schemata of appropriate information and structure from those of less appropriate information and structure. Although this process would provide a quality measurement (versus establishing general analytic criteria as was done in this study), it would not necessarily provide insights into the amount of cognitive capacity required to process the schemata accessed for a given task. Because engagement reflects the amount of memory space and effort required for a given task, engagement indicates the degree of development of the schemata accessed.

Writing models have existed for two decades now, starting with Rohman's in 1965. Flower and Hayes (1981)

added new dimensions to writing models by linking writing processes with memory processes. Glynn, et al., (1982), have investigated the effect of human memory variables on writers of varying abilities via their final-written products. As in any field that is entering a new research dimension, writing researchers must begin developing valid means by which to measure emerging constructs. The networking notion demonstrated by Thorndyke (1977) may be a valid addition to the relationships between engagement and quality as a measurement of the goodness of writing schemata.

REFERENCES

Atkinson, R. C. & Shiffrin, R. M. (1971). The control of short-term memory. Scientific American, 225(2), 82-90.

Baddeley, A. D. (1978). The trouble with levels: A reexamination of Craik and Lockhart's framework for memory research. Psychological Review, 85, 139-152.

Bever, T. G. (1973). Serial position and response biases do not account for the effect of syntactic structure on the location of brief noises during sentences. Journal of Linguistic Research, 2, 287-288.

Bracewell, R. J., Frederiksen, C. H., & Frederiksen, J. D. (1982). Cognitive processes in composing and comprehending. Educational Psychologist, 17(3), 146-164.

Britton, B. K., Piha, A., Davis,J., & Wehausen, E. (1978). Reading and cognitive capacity usage: Adjunct question effects. Memory and Cognition, 6, 266-273.

Britton, B. K., Westbrook, R. D., & Holdredge, T. S. (1978). Reading and cognitive capacity usage: Effects of text difficulty. Journal of Experimental Psychology: Human Learning and Memory, 4, 582-591.

Britton, B. K., Holdredge, T.S., Curry, C., & Westbrook, R. D. (1979). Use of cognitive capacity in reading identical texts with different amounts of discourse level meaning. Journal of Experimental Psychology, 5(3), 262-170.

Britton, B. K., Meyer, B. J. F., Simpson, R., Holdredge, T., & Curry, C. (1979). Effects of organization of text on memory: Test of two implications of a selective attention. Journal of Experimental Psychology: Human Learning and Memory, 5, 496-506.

Britton, B. K., Glynn, S., Meyer, B. J. F., & Penland, M. J. (1982). Effects of text structure on use of cognitive capacity during reading. Journal of Experimental Psychology: Human Learning and Memory, 5, 496-506.

Britton, J., Burgess, T., Martin, N., McLeod, A., & Rosen, H. (1975). The development of writing ability (11-18). London: MacMillan Education.

Broadbent, D. E. (1958). Perception and communication. London: Pergamon Press.

Bruce, B., Collins, A., Rubin, A. D., & Gentner, D. (1982). Three perspectives on writing. Educational Psychologist, 17(3), 131-145.

Burke, K. (1945). A grammar of motives. Berkeley: University of California.

Burton, J. K. (1982). Cognitive capacity usage during prose processing. Blacksburg, VA: College of Education, Virginia Tech. (ED 224 818).

Carroll, J. M. (1979) "Mere length" and sentence comprehension units: A argument from ambiguity bias. Papers in Linguistics, 12.

Carroll, J. M. & Tanenhaus, M. (1978). Functional clauses and sentence segmentation. Journal of Speech and Hearing Research, 21, 793-808.

Collins, A. M. & Quillian, M. R. (1969). Retrieval from semantic memory. Journal of Verbal Learning and Verbal Behavior, 8, 240-247.

Craik, F. I. M. & Lockhart, R. S. (1972). Levels of processing: A framework for memory research. Journal of Verbal Learning and Verbal Behavior, 11, 671-684.

Crowhurst, M. & Piche, G. L. (1979). Audience and mode of discourse effects on syntactic complexity. Research in the Teaching of English, 13, 101-109.

D'Angelo, F. J. (1976). Modes of discourse. In G. Tate (Ed.), Teaching composition: 10 bibliographical essays. Ft. Worth, TX: Texas Christian University Press.

Daiute, C. A. (1984). Performance limitations on writers. In R. Beach & L. S. Bridwell (Eds.), New directions in composition research. New York: The Guilford Press, 205-224.

Fiske, S. T. & Linville, P. W. (1980). What does the schema concept buy us? Personality and Social Psychology Bulletin, 6, 543-557.

Flower, L. (1979). Writer-based prose: A cognitive basis for problems in writing. College English, 41, 19-37.

Flower, L. & Hayes, J. R. (1980). The dynamics of composing: Making plans and juggling constraints. In L. W. Gregg & E. R. Steinberg (Eds.), Cognitive processes in writing, (pp. 31-50). Hillsdale, N. J.: Erlbaum.

Flower, L. & Hayes, J. R. (1981). Plans that guide the composing process. In C. H. Frederiksen, M. G. Whiteman, & J. F. Dominic (Eds.), Writing: The nature, development, and teaching of written communication (Vol. 2). Hillsdale, N. J.: Erlbaum.

Flower, L. (1984). Images, plans, and prose: The representation of meaning in writing. Written Communication, 1, 120-160.

Fodor, J. A. & Bever, T. G. The psychological reality of linguistic segments. Journal of Verbal Learning and Verbal Behavior, 4, 414-420.

Garrett, M. F., Bever, T. G., & Fodor, J. A. (1966). The active use of grammar in speech perception. Perception and Psychophysics, 1, 30-32.

Glynn, S. M., Britton, B. K., Muth, D. K., & Dogan, N. (1982). Writing and revising persuasive documents: Cognitive demands. Journal of Educational Psychology, 74, 557-567.

Hasher, L. & Zacks, R. T. (1979). Automatic and effortful processes in memory. Journal of Experimental Psychology: General, 3, 356-388.

Hunt, K. (1970). Syntactic maturity in school children and adults. Monographs of the Society for Research in Child Development, 35, (serial No. 134).

Johnston, W. A. & Heinz, S. P. (1978). Flexibility and capacity demands of attention. Journal of Experimental Psychology: General, 4, 420-435.

Kahneman, D. (1973). Attention and effort. Englewood-Cliffs, N. J.: Prentice-Hall.

Kerr, B. (1973). Processing demands during mental operations. Memory and Cognition, 1, 401-412.

Kirk, R. E. (1968). Experimental design: Procedures for the behavioral sciences. Belmont, CA: Wadsworth.

Klatzky, R. (1980). Human memory: Structures and processes (2nd ed.). San Francisco: W. H. Freeman and Company.

Langer, J. A. (1984). The effects of available information on responses to school writing tasks. Research in the Teaching of English, 18, 27-44.

Miller, G. A. (1956). The magical number seven, plus or minus two: Some limitations on our capacity for processing information. Psychological Review, 63, 81-97.

Moffett, J. & Wagner, B. J. (1983). Student-centered language arts and reading, K-13: A handbook for teachers. (3rd ed.). Boston: Houghton-Mifflin.

Neisser, U. (1975). Cognition and reality: Principles and implications of cognitive psychology. San Francisco: Freeman.

Norman, D. A. (1978). Notes toward a theory of complex learning. In A. M. Lesgold, J. W. Pellegrino, S. D. Fokkema, & R. Glaser (Eds.), Cognitive psychology and instruction. New York: Plenum Press.

Osgood, C. E. (1949). The similarity paradox in human learning: A resolution. Psychological Review, 56, 132-143.

Posner, M. I. & Boies, S. J. (1971). Components of attention. Psychological Review, 78, 391-408.

Rockas, L. (1964). Modes of rhetoric. New York: St. Martin's Press.

Rubin, D. L. & Piche, G. L. (1979). Development in syntactic and strategic aspects of audience adaptation shown in written persuasive communication. Research in the Teaching of English, 13, 293-316.

Rumelhart, D. E. (1975). Notes on a schema for stories. In D. G. Bobrow & A. M. Collins (Eds.), Representation and Understanding. New York: Academic Press.

Rumelhart, D. E. & Ortony, A. (1977). The representation of knowledge in memory. In R. C. Anderson, R. J. Spiro, and W. E. Montague (Eds.), Schooling and the Acquisition pf Knowledge. Hillsdale, N. J.: Erlbaum.

Stallard, C. K. (1974). An analysis of the writing behavior of good student writers. Research in the Teaching of English, 8, 206-218.

Strickland, R. (1962). The language of elementary school children. Indiana University School of Education Bulletin, 38, 1-131.

Thorndyke, P. W. (1977). Cognitive structures in comprehension and memory of narrative discourse. Cognitive Psychology, 9, 77-110.

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THE EFFECTS OF WRITING ABILITY AND MODE OF DISCOURSE ON COGNITIVE CAPACITY ENGAGEMENT

by

William Michael Reed

(ABSTRACT)

In this study, the effects of writing ability and mode of discourse of cognitive capacity engagement were investigated. Sixty-three college freshmen of varying writing abilities (basic, average, and honors) were randomly assigned to experimental treatments (descriptive writing, narrative writing, and persuasive writing). Using the secondary task method, it was found that writing ability differentially affects cognitive capacity engagement across modes. For example, honors writers were least engaged when writing descriptive essays but were most engaged when writing persuasive essays whereas average writers were most engaged when writing descriptive essays but were least engaged when writing narrative essays.

Analytic quality scores and engagement were related and results were interpreted in the context of schema theory to estimate the learning potential of a given mode of discourse. Also, engagement and syntactic complexity measures were related. It was found that as words per clause increased, engagement also increased; whereas, as clauses per T-unit increased, engagement decreased.