Review of Educational Research
Winter 1987, Vol. 57, No. 4, pp. 481–506

Research on Revision in Writing

Jill Fitzgerald
University of North Carolina at Chapel Hill

Views of revision and its role in writing have changed dramatically over the last two decades. This article first presents a historical perspective on revision and suggests a contemporary definition of revision. Next, it reviews research methods for examining revision. The evolving methods mirror the recent reconceptualization of revision by enabling investigation of the following: meaningful revision activity, not just editorial actions; the revision process as well as the revision products; and revision as it occurs at several points in writing. Findings from research on revision are synthesized, conclusions about the results are given, and limitations of the research are examined.

Revision is commonly regarded as a central and important part of writing (Lowenthal, 1980; Murray, 1978a; Scardamalia & Bereiter, 1986). Revision is significant partly because under certain circumstances it may enhance quality of final written work (Ash, 1983; Bamberg, 1978; Bracewell, Scardamalia, & Bereiter, 1978; Bridwell, 1980) and partly because, when writers use revision to rework thoughts and ideas, it may powerfully affect writers' knowledge. Revision enables writers to muddle through and organize what they know in order to find a line of argument, to learn anew, and to discover what was not known before (Sommers, 1980).

Although the amount of research on revision is still relatively meager, a growing body of knowledge accumulated from a set of diverse methodologies is beginning to inform us about the process of revision and about writers' revision efforts. This paper presents a brief historical perspective on the development of the meaning of revision, presents findings from research on revision, and, finally, discusses limitations of the research.

Perspectives on Revision

Historical trends in perspectives on revision provide a necessary framework for understanding research on revision. Traditionally, practitioners have claimed that revision is an important part of writing (Hodges, 1982), and analyses of famous authors' revision efforts support the notion that good writing entails considerable revision (Hildick, 1965). As Hodges carefully demonstrates, however, theory has not always mirrored the practitioner's belief that revision has a central role in writing. Early views of revision were theoretically dry and uninteresting. Aristotle's *Rhetoric* (1984), for example, focused on finding and structuring, rather than creating, content. De-emphasis on creativity allowed little opportunity for revision. Consequently, for Aristotle, alterations were confined to sentence-level

I would like to thank Lynda Markham (Alma College, Michigan) and two anonymous reviewers for comments on earlier drafts of this paper.

polishing, or what today might be termed editing, and were seen as only one aspect of revision. The conception of revision as error correction lingered for many centuries (Lyman, 1929; Tressler, 1912).

It was not until the 1970s that fuller theoretical attention to revision emerged. Even in the 1970s and 1980s, revision was rarely defined in the literature. But among the rare discussions of revision that do appear, shifts in perspectives over the last 15 years are immediately evident. The shifts in perspectives reflect changes in thinking about writing in general. Until the 1970s, writing was viewed predominantly as a linear model consisting of prewriting, writing, and postwriting (Britton, Burgess, Martin, McLeod, & Rosen, 1975; Rohman, 1965; Rohman & Wlecke, 1964). Murray (1978a) recast the three components as prevision, vision, and revision. Perhaps among the first to point to and study the importance of revision, Murray (1978a) defined revision as "what the writer does after a draft is completed to understand and communicate what has begun to appear on the page" (p. 87). Murray (1978a) talked about revision as "seeing again," and he discussed two principal forms of revision: internal revision, or "everything writers do to discover and develop what they have to say," and external revision, or "what writers do to communicate what they have found" (p. 91). The specification of internal and external revision was a forerunner to later explorations of the process of revision (i.e., the mental workings) and the product of revision (i.e., the marks made on the page). Murray's (1978a, 1978b) focus on "seeing again" and on internal mental formulations was central among his contributions to the development of an understanding of revision. Though Murray's work on revision was embedded in a linear or stage model of writing, his work can be seen as a transition (a) from a time when revision received little or no theoretical attention to a time when the meaning of revision began to take shape, (b) from a longstanding view of alterations in text as relatively minor editorial changes to a new view of text changes as including reflections of major and/or meaty reconceptualizations of ideas and meanings, and (c) from a product-focused view of revision to an increasingly process-oriented one.

In the 1970s, several factors converged to dramatically affect the study of writing (Scardamalia & Bereiter, 1986). The public and the educational community were increasingly concerned about writing skills, and cognitive psychology and the study of psycholinguistic processes were rapidly expanding. Also a methodological turning point occurred in writing research. Prior to the 1970s, experimental research dominated the writing field. Its quantitative emphasis tended to bind researchers to the study of written products (Humes, 1983). Marrying other methodologies (such as case studies and naturalistic inquiry) with the ever-growing interest in cognition probably both engendered and allowed more research on the process of writing. The upshot was that ensuing research "discredited the linear model of the composing process" (Humes, 1983, p. 205) and supported a dynamic hierarchical cognitive theory of writing, involving planning, transcribing, and reviewing. The new model had potential for recursiveness (Flower & Hayes, 1981b). That is, writers could move back and forth among subprocesses, subprocesses could be embedded in other processes, and some processes might be embedded as parts of themselves (e.g., editing is a subprocess of writing, but writing may interrupt editing).

The effects of the predominant contemporary perspective of writing on views

of revision were to stir things up in at least three ways. First, if subprocesses could be hierarchically embedded, then revision could occur at any time in the composing process, before, during, and after putting pen to paper (cf., Lowenthal, 1980). As Scardamalia & Bereiter (1986) asserted, "It makes little psychological sense to treat changing a sentence after it is written down as a different process from changing it before it is written" (p. 783).

Second, thinking of revision as something that could be embedded in other subprocesses of writing, such as planning, helped build the notion that revision means more than making minor editorial changes. Consistent with Murray's (1978a) thinking, revision was now viewed as both surface- and meaning-based, and both microstructure- and macrostructure-related (Kintsch & van Dijk, 1978; van Dijk, 1980). Nold (1979), for example, said that it

> is not just correcting the lexicographic and syntactic infelicities of written prose. . . . It also includes (1) changing the meaning of the text in response to a realization that the original intended meaning is somehow faulty or false or weak . . . , (2) adding or substituting meaning to clarify the originally intended meaning or following more closely the intended form or genre of the text . . . , (3) making grammatical sentences more readable by deleting, reordering, and restating . . . , as well as (4) correcting errors of diction, transcription and syntax that nearly obscure intended meaning or that are otherwise unacceptable in the grapholect." (pp. 105–106)

Third, some researchers invested energy in detailing the process of revision, that is, what goes on in an author's mind as revisions occur. However, as interest in the process of revision increased, it also became significantly more difficult to interpret what was meant by the term "revision." Researchers of the early 1980s seemed to disagree about whether the term "revision" referred to the product, that is, the changes that are made, or to the process authors go through in their minds, or to both. Sommers (1980), for example, may have believed it was both. She said that revision is bringing the writing into line with the writer's intentions. Likewise, Beach's (1984) problem-solving model and Bridwell's (1980) model of revision appear to include both the mental process and the actual changes made. Scardamalia and Bereiter (1983), on the other hand, preferred to separate revision process and products, saying that their model of the process of making textual changes was not called a model of revision because revision refers to something that happens to a text. However, their model included actually making the change, that is, it included "something that happens to a text," a product. Most recently, Scardamalia and Bereiter (1986) coined the term "reprocessing" to refer to the mental aspects of revision, saying that "reprocessing is a more suitable theoretical term than revision because it refers to what goes on mentally rather than being tied to differences in surface behavior" (p. 790). Reprocessing "spans everything from editing for mistakes to reformulating goals. Revision is a special case of reprocessing, applied to actual text" (p. 790). Again, the term "revision" was reserved for making the actual change (a product), but it was embedded in or subsumed under the mental operation (a process). Similarly, Hayes and Flower (1983) used the term "reviewing" to refer to "the act of evaluating either what has been written or what has been planned" (p. 209), adding that reviewing could lead to revisions. Reviewing seemed to refer to the mental process and revision to the product, that is, the actual changes.

Though the variations in labeling created confusion, some consensus about how revision occurs can be gleaned from Bridwell's (1979, 1980) view of revision, Beach's (1984) problem-solving model of revision, Scardamalia and Bereiter's (1983) compare/diagnose/operate (CDO) part of the composing process, and Flower, Hayes, Carey, Schriver, and Stratman's (1986) working model of revision. Each model is related to or grew out of Flower and Hayes's (1981a) problem-solving view of writing and their discussion of reviewing, evaluating, revising, and editing (Bartlett, 1982; Hayes & Flower, 1980a, 1980b, 1983). The problem-solving view of revision may also be rooted in or related to some researchers' stress on the role of dissonance in revision, that is, the recognition of incongruities between goals and instantiated text (Della-Piana, 1978; Faigley & Skinner, 1982; Flower & Hayes, 1981a; Perl, 1980; Sommers, 1980).

Details of the views vary slightly, but a characterization can be drawn that captures the essence of each.

1. Writers identify discrepancies between intended and instantiated text. (Though most researchers do not specify it, presumably "text" can refer to text in the writer's mind before setting pen to paper.) For writing to be judged successful or high in quality by others, identification of discrepancies most likely requires knowledge of characteristics of "good" writing, ability to recall and represent relevant knowledge, and ability to write/read one's own writing from a reader's perspective (Bartlett, 1982).

2. Writers diagnose; when problems are identified, authors determine what changes can be or need to be made, as well as alternatives for how the changes can be made.

3. Writers operate; actual changes are carried out.

Explicit, detailed written definitions of revision rarely exist in the literature. However, the following paragraph gives an implicit contemporary definition of revision, broadly conceived to encompass both process and product:

Revision means making any changes at any point in the writing process. It involves identifying discrepancies between intended and instantiated text, deciding what could or should be changed in the text and how to make desired changes, and operating, that is, making the desired changes. Changes may or may not affect meaning of the text, and they may be major or minor. Also, changes may be made in the writer's mind before being instantiated in written text, at the time text is first written, and/or after text is first written (Beach, 1984; Bridwell, 1980; Faigley & Witte, 1981; Flower & Hayes, 1981a; Flower et al., 1986; Nold, 1981; Scardamalia & Bereiter, 1983, 1986).

This definition guided the work of the present review. Any research that explored the mental or the pen-to-paper aspects of revision as defined immediately above was included, regardless of whether the concept was labeled "revision," "editing," "reprocessing," or something else.

Measuring and Revealing Revision

Until the late 1970s, revelation of revision and revision processes was limited to personal testimonies of how revision occurs and what it means (e.g., Cowley, 1958; Dembo & Pondrom, 1972; Murray, 1978a; Plimpton, 1963, 1967, 1976; van Gelder, 1946) and to analyses of famous authors' revisions made over drafts of their own works (Hildick, 1965). Over the last decade, particularly during the last

few years, methods of revealing individuals' knowledge of revision, as well as actual revisions made on paper, proliferated. The development of methodology mirrored the 1970s' and 1980s' reconceptualization of revision as potentially major and significant in nature, not just editorial, as both process and product, and as a subprocess that could occur at any point in the writing process. Five clusters of research methods emerged: coding systems for categorizing revisions; process-tracing methods, including think-aloud techniques, questionnaires, interviews, and taped self-evaluations; a participant-observer method; a simulation by intervention method; and an error detection method.

Coding Systems for Categorizing Revisions

Coding systems and accompanying procedures for collecting evidence of revisions gradually developed during the 1970s and 1980s. Their development paralleled the evolution of the theoretical perspective on revision except that they focused solely on written products, revealing much about when and what revisions were made, but little about process.

Though some earlier analysts of revisions of well-known writers used global classifications for revisions, such as "tidying up changes" and "structural alterations" (Hildick, 1965), Stallard's (1974) work and a National Assessment of Educational Progress (NAEP) (1977) report were among the landmark pieces that initiated the growth of coding schemes. In Stallard's seminal study, 12th graders wrote one essay and were asked not to erase, but to draw a line through anything they wanted to change. Stallard classified marks according to six types (spelling, syntax, multiple-word, paragraph, punctuation, and single-word changes). In the NAEP study of revision, 9-, 13-, and 17-year-olds were given 15 to 18 minutes to write (in pencil) a report or a letter of complaint, followed by an additional 13 minutes to make the work better, using a pen. They could mark on the original draft and were given the opportunity to redo the work in a clean space. Changes were coded into nine categories ranging from cosmetic to informational and organizational.

Several problems were associated with the early coding schemes. One problem was that the schemes seemed to lack well-developed theoretical bases. Second, the categories within each scheme were not mutually exclusive. For example, changes involving syntax might also be changes of multiple words. Third, meaning and surface changes were not clearly distinguished. Fourth, some kinds of revision operations, such as adding and deleting, were not accounted for.

The next set of coding schemes and their accompanying procedures addressed some of the limitations in earlier work. Bridwell (1979, 1980) had 12th graders write and revise one explanatory essay (but with some choice in topic) over a 3-day period. On Day 1, the assignment was given and prewriting or note making was done; on Day 2, the students wrote with blue pens. On Day 3, using black pens, they could revise on the first draft and write a second draft. Three stages of revisions were then analyzed: in-process revisions while writing the first draft, between-draft revisions (i.e., changes made in the draft written in black that were not noted in the draft written in blue), and in-process revisions while writing the last draft in black ink. Sommers (1980) used a similar procedure.

Advancements noted in Bridwell's (1979, 1980) and Sommers's (1980) coding schemes were that revision operations and linguistic levels were distinguished,

and revision categories were mutually exclusive. Also, a procedure emerged for analyzing revisions at several points in the writing process (Bridwell, 1980).

The most recently developed coding system captured many of the advantages of preceding ones and transcended them. Using Bridwell's (1980) procedures for data collection, but building on research in discourse analysis (Clark, 1977; Crothers, 1978, 1979; Halliday & Hasan, 1976; Kintsch, 1974; Meyer, 1975; van Dijk, 1980), Faigley and Witte (1981, 1984) devised the first taxonomy of revisions that would account for revisions related to the semantic structure of text, not just syntactic aspects. The taxonomy distinguished characteristics of changes such as surface and meaning and microstructure and macrostructure features. Also, six types of operations (such as adding or deleting) and six linguistic levels (such as graphic or lexical changes) were coded.

Clearly the most comprehensive of the coding schemes available to date, the taxonomy and the accompanying procedure for data coding seemed to have one salient drawback, namely, they were used to analyze only in-process and between-draft changes once pen has met paper. Changes made before pen meets paper probably cannot be coded using the taxonomy (Witte, 1985).

Process-Tracing Methods

Process-tracing methods allow researchers to gain insight into writers' thinking by observing them and recording their behaviors and by asking them in either a general or a directed way about their performance and/or about decisions or thoughts. At least four main types of process-tracing techniques have emerged in research on revision: asking individuals to think aloud while writing, questionnaires, interviews, and asking individuals to tape evaluations of their work after each draft.

Typically, in a think-aloud study, writers are asked to verbalize their thinking process while they write for about 60 to 90 minutes during one to four sessions (Hayes & Flower, 1980a; Perl, 1979). Their thoughts are tape recorded and later transcribed. The transcriptions are referred to as "think-aloud protocols." The protocols are analyzed descriptively and/or quantitatively using indexes such as counts of interjections and content ideas. Hayes and Flower (1980a) give a thorough and clear description of protocol analysis, complete with a detailed example.

Although the think-aloud technique still holds promise as a useful means of determining how revision occurs, to date, revision has been only a peripheral focus in such studies, documenting that thinking about revision does occur and that revision appears to be a goal-directed process that can take precedence over and interrupt all other writing processes at any time (Hayes & Flower, 1980a, 1980b; Perl, 1978, 1979). More specific information about how revision happens has not so far emerged from think-aloud research.

Beach (1979, 1984) and Beach and Eaton (1984) used a type of questionnaire called a "guided self-assessing form" to determine facets of writers' goals and strategies that precipitated revision. The form was used as an intervention technique (Beach, 1979; Beach & Eaton, 1984) and as an outcome measure (Beach, 1984), but in each case it was also used to reveal writers' thoughts. After completing prewriting and a draft, students filled out the form, which asked them first to define their overall goal and audience. Next they divided their drafts into sections by paragraphs. For each section, they had to describe what they were trying

to say, the strategies they used, and audience characteristics. Finally, they listed questions or problems they had in each section. In one study (Beach & Eaton), responses were then analyzed into categories of strategies such as thesis, backgrounding, and lexical items. Each strategy category was divided into inferences that described (e.g., "I am giving some background") versus ones that judged (e.g., "I didn't give enough examples to support my point") the use of a strategy type. In another study (Beach, 1984), responses regarding students' intentions, problems in fulfilling intentions, and predicted revision inferences were rated using a 3-point degree-of-specificity scale.

Interviews have occasionally been used to gain insight into thoughts about revision. Stallard (1974) and Sommers (1980) used retrospective interviews. Stallard interviewed senior high school writers immediately after observing them while they write. She asked about things they remembered consciously attending to and feeling concerned about while writing, such as if they thought about the intended reader. Data were categorized and analyzed descriptively and by percentages (e.g., 40% of the good writers said they made a mental outline before beginning to write). Sommers interviewed writers about revisions after their first, second, and third drafts of three essays. From transcriptions of the taped interviews, Sommers developed a scale of writers' primary, secondary, and tertiary concerns.

Fitzgerald and Markham (1987) used a prospective interview with sixth graders after a first session of writing and before a second session providing opportunity to revise. First, students identified specific spots where something could or should be changed. For each spot identified, students were asked about reasons or goals for the change and about how the change could or should be made. Data were coded in a variety of ways, such as the degree to which goals were specific and what types of changes were suggested.

A final process-tracing method used in studies of revision is "taped self-evaluation." Beach (1976) asked college students to write, tape their evaluation of the draft, and then to write as many drafts as necessary, taping their evaluations after each draft. Responses were analyzed descriptively to determine characteristics such as conceptions of the revision process.

A Participant-Observer Method

Participant-observer research that yielded information about the development of revision was fashioned mainly by Graves and his associates (Calkins, 1979, 1980a, 1980b, 1982; Gentry, 1980a, 1980b; Graves, 1981b, 1983; Graves & Murray, 1980). In participant-observer research, typically, the investigator works in a classroom, observing and recording through notes and tapes, and videotapes events, sometimes also helping the teacher and/or the students. Anecdotes and rich and detailed narrative accounts written by the investigator constitute the mainstay data. Results are summarized descriptively.

Simulation-by-Intervention Methods

A recent and innovative method called "simulation by intervention" was designed to investigate composing strategies or abilities by structuring tasks to simulate common writing situations or processes (Bereiter & Scardamalia, 1983; Cattani, Scardamalia, & Bereiter, 1981; Scardamalia & Bereiter, 1983; Scardamalia,

Bereiter, Gartshore, & Cattani, 1980). Though sometimes cumbersome and painstaking for subjects, the simulation-by-intervention method is unique and imaginative and holds promise for revealing new perspectives on how writers think about revising.

In one simulation-by-intervention technique, researchers postulated a model of the mental process involved in revision and then developed an intervention sequence called "procedural facilitation" to ease writers' use of the hypothesized process. The hypothesized model was the earlier mentioned CDO model proposed by Scardamalia and Bereiter (1983). During procedural facilitation, writers were required to implement a compare/diagnose/operate process, but the process was simplified for them through an opportunity to choose, from sets of standard evaluative and diagnostic statements (such as "People won't see why this is important," "I think this could be said more clearly," and "I'd better say more"), statements that they thought best characterized the sentences. In two examples, students wrote and were stopped periodically and asked to select evaluative, diagnostic, and tactic statements, and then to carry out any desired revisions (Scardamalia & Bereiter, 1983, 1985).

While simulating the CDO process, the routine decreased demands on students' attentional resources, yet permitted the rest of the composing process to remain essentially intact and allowed underlying competencies to appear. Thus, difficulties in each of the three aspects of the CDO process, as well as in the integration of them, could be ascertained.

Another structured simulation task was used by Lehrer and Comeaux (1987). Students read a paragraph on a familiar topic, read a list of 11 details, and were asked to insert at least 4 of the details into the paragraph. Some of the details could be inserted without violating either the local coherence between individual sentences or the global coherence (the gist of the paragraph), some were globally incoherent (irrelevant to the topic or gist of the paragraph), and some were locally incoherent (relevant to the general topic, but not relevant in the particular paragraph). Because they carefully manipulated features of details presented in the list, the researchers could analyze students' choices to gain insight into which levels of textual constraints (global and/or local) guided students' revision choices.

To examine students' ability to manipulate surface-level features of text (syntax) so as to better reflect intended meaning, Bracewell (1987) used a structured simulation task in which students wrote compositions and then met individually with the investigator, who underlined parts of sentences and asked the students to paraphrase them, beginning with the underlined part. Students then decided whether the original or revised version was better and justified their choices. The revisions, in conjunction with thoughtful experimenter sentence selection and student explanation for choices, helped to provide insight into (a) what revisions writers *could* carry out with external support and (b) ability to coordinate written and intended texts.

An Error-Detection Method

To gain insight into writers' identification of spots or ideas for revision and their choices of how to make revisions, Hull (1984) and Lehrer and Comeaux (1987) used an error-detection-and-correction paradigm. Students read self-written and/or rigged passages that had surface-level errors (such as incorrect spelling

or misplaced transitions like "however") or global-level errors that needed to be deleted or moved. Students were told to make changes or corrections. Hull also asked students to explain aloud why they made the change. Quantitative and descriptive data then provided insight into the students' abilities to notice problem spots, as well their reasoning about making changes.

Findings

Research on Cognitive Aspects of the Current Problem-Solving View of the Revision Process

Research on cognitive aspects of the problem-solving view of revision has focused on reasons for breakdowns. Several reasons are plausible. First, one breakdown may occur if a writer does not clearly establish intentions for text. Beach and Eaton (1984) did find that college students had considerable difficulty specifying intentions for their writing.

Intentions may be for content or for form or presentation (Bracewell, 1980), so writers may have difficulty establishing intentions because of lack of knowledge about what to say (i.e., about content-related goals) and/or because of lack of knowledge about how to say it (i.e., about presentation-related goals such as structure, style, format, etc.). On the other hand, writers may actually have the requisite knowledge, but may have difficulty recalling and/or representing the knowledge (Bartlett, 1982; Flower et al., 1986).

Little research has been done to sort out the possibilities. One study suggested that lack of presentation-related knowledge at the discourse level (or ability to recall it) may be an inhibiting factor. Bracewell, Bereiter, and Scardamalia (1980) supported 9- and 11-year-old writers by pointing out structural features of their compositions which could be revised while allowing the writers to supply their own content. Children were able to improve the content when the discourse-level knowledge was provided for them.

Second, simultaneously juggling presentation- and content-related goals may affect revision. Results of one case study of a dissertation writer suggest that the revision process actually may be blocked when presentation-related goals are in conflict with, or take precedence over, expression-of-content goals (Galbraith, 1980). Similarly, when writing brief persuasive documents, college freshmen contending with more presentation-related facets of text tend to make fewer content-related revisions from first to last drafts (Glynn, Britton, Muth, & Dogan, 1982).

Third, to create texts judged readable by others, establishment of intentions and identification of discrepancies between intended and instantiated text require ability to write/read one's own writing from a reader's perspective. Bartlett (1982) and Flower et al. (1986), for example, discussed the crucial importance of an author's ability to inhibit interpretations of the text based on one's own intentions while taking on the reader's nonprivileged view.

Egocentrism is often suggested as a reason for an inability to establish intentions and identify discrepancies between intended and actual text (Flower, 1979; Graves, 1981a; Kroll, 1978). Research findings are limited and mixed on this point. Bartlett (1982) found that elementary school children detected problems and revised substantially more when they worked with texts written by others, indicating that egocentrism does seem to be a plausible contributing factor to a breakdown

in the revision process. However, Bracewell, Bereiter, and Scardamalia (1979) found that when children revised texts written by themselves and by others, the only difference was that they identified more spelling errors in the texts of others.

Fourth, limited evidence suggests that children may be aware that discrepancies between intended and actual text exist, but they have difficulty determining what/where changes need to be made. Scardamalia and Bereiter (1983) found that children did not agree with experts about the source of perceived difficulties, often focusing on overly specific details, whereas experts dealt more with issues at the text level.

Fifth, limited evidence suggests that children have difficulty knowing how to make desired changes, but competence may improve from fourth grade through eighth grade. Scardamalia and Bereiter (1983) found that when students' indications of how to make changes were rated by an expert as high-probability or low-probability choices for dealing with the identified problem, high-probability choices increased from 50% at grade 4 to 74% at grade 8.

Sixth, a writer may have trouble carrying out the desired operations. However, inability to execute desired operations does not appear to be highly supported in the literature. Writers do appear to carry out more revision and more appropriate revision when revising texts of others (Bartlett, 1982), high school students revise more when teachers evaluate their work than when students evaluate their own pieces (Beach, 1979), and sixth graders can make syntactical revisions when spots for the revisions are located for them (Bracewell, 1987).

Seventh, a writer may possess all or most of the separate knowledge and abilities, but may have difficulty managing the entire process, that is, there may be a breakdown in executive control over the components involved in the revision process (Scardamalia & Bereiter, 1983). This hypothesis is heavily supported in a series of simulation-by-intervention studies by Scardamalia and Bereiter and colleagues (Cohen & Scardamalia, 1983; Scardamalia & Bereiter, 1983, 1985, 1986; Scardamalia, Bereiter, Gartshore, & Cattani, 1980). Results showed that when possible problems with executive control were minimized through a supportive routine, students performed revisions at higher linguistic levels than is typical.

In sum, although research so far supports the problem-solving view of revision, speculation about reasons for breakdowns in the process is only beginning, and research on cognitive aspects of the problem-solving view is in its infancy.

How Much, When, and What Kinds of Revision: Effects of Expertise and Age

Most revision research has addressed how much revision occurs, when it occurs, and what kinds of revisions are made. Conclusions about each of the three issues are somewhat dependent on writers' expertise or ages. Some children do begin revising when they begin to write (Calkins, 1980b; Graves, 1975, 1979; Smith, 1982), but, generally, beginning writers do not revise very much (Calkins, cited in Gentry, 1980a; Graves & Murray, 1980). Younger students, and even many older students, do very little revision without peer group or teacher support (Butler-Nalin, 1984; Emig, 1971; Freedman & Pringle, 1980; Gould, 1980; Graves, 1979; Markham, 1983; NAEP, 1977; Nold, 1981; Scardamalia & Bereiter, 1986). Though there is marked individual variation (Faigley & Witte, 1981; NAEP &

Educational Testing Service [ETS], 1986), revision behavior tends to change with age and/or competence.

Most of the studies on how much and when to revise and what kind of revisions are made have focused on revision products that appear on paper, though a few have investigated changes writers make in their minds between drafts. Virtually no attention has been given to changes made in the mind before pen meets paper.

It is important to recognize that although counts of overall amount of revision and of types of revision do tell that revision is occurring, they do not tell whether it is a lot, a little, or enough, or even if it is the "right" kind. To address such an issue, researchers would need to examine revisions in light of "what's needed." Very few studies have attempted to do so, and no clear patterns emerge as yet. One way to examine the issue is to compare writers' choices and decisions to those of experts. Faigley and Witte (1981), for example, found little correspondence in revision operations between expert adult writers and inexperienced adult writers when both groups revised the inexperienced writers' first drafts. On the other hand, Scardamalia and Bereiter (1983) found that although fourth graders' choices of revision tactics did not match those of a semiprofessional writer very well, sixth graders' choices matched better, and eighth graders' choices matched quite well. Also, the students' sentence-by-sentence evaluations of their texts corresponded closely to the semiprofessional writer's, but justifications of their evaluations did not.

Another way to examine the relationship between revisions and "what's needed" is to estimate the quality of each revision. Scardamalia and Bereiter (1983), for example, found more of fourth, sixth, and eighth grade students' changes were judged to be for the better rather than the worse, though results should be interpreted cautiously since the reliability estimate for the judgments was very low.

How much revision. The recent NAEP and ETS (1986) summary surprisingly indicates that students at least believe that they do a fair amount of revising. Of the fourth graders surveyed, for example, 60% reported that they made changes in their last paper before handing it in, and 69% said that they regularly revised papers. When interpreting these data, it is important to remember that they were unverified self-reports.

Averages reported for older students, adults, and one group of sixth graders for amounts of revisions made on paper ranged from 14 to 34 revisions per 100 words (Bridwell, 1980; Faigley & Witte, 1981; Fitzgerald & Markham, 1987), though Stallard (1974) reported a much lower figure of 4.26 revisions per paper for a randomly selected group of 12th graders, and Pianko (1977) reported 3.03 changes per 100 words for college freshmen. Some variability in results across studies may be due to different ways of counting revisions.

There is considerable variation in the amount of revision that goes on within both expert and inexpert (or younger) groups of writers (Bridwell, 1980; Della-Piana, 1978; Dembo & Pondrom, 1972; Emig, 1971; Faigley & Witte, 1981; Scardamalia & Bereiter, 1986; Wason, 1980). However, at the high school level and beyond there is a tendency for more competent writers to make more revisions, up to twice as many as less competent ones or slightly younger ones (Maynor, 1982; Monahan, 1982; Stallard), although exceptions to this generalization have

been noted (Ash, 1983; Faigley & Witte, 1981). Counts of revisions for younger writers are scarce.

When revision occurs. Research with both elementary and university students supports the belief that certain kinds of revision go on before pen meets paper. Spontaneous changes have been documented between words students say they are about to write and words they do write (de Beaugrande, 1984; Scardamalia & Bereiter, 1986; Scardamalia, Bereiter, & Goelman, 1982), and between changes students say could or should be made on a following draft and changes actually made (Fitzgerald & Markham, 1987). Both youngsters (as young as 10) and older competent and less competent writers make major changes in their minds between plans and eventual written texts (Burtis, Bereiter, Scardamalia, & Tetroe, 1983). Similarly, there is evidence of revision while writing (Bridwell, 1980; Faigley & Witte, 1981; Fitzgerald & Markham; Stallard, 1974) and between written drafts (Bridwell, 1980; Faigley & Witte, 1981; Fitzgerald & Markham).

Some limited evidence suggests that for older individuals, more competent writers do more revising while composing a first draft than do less competent writers (Bridwell, 1980; Faigley & Witte, 1981). Similarly, 4th-, 8th-, and 11th-grade students tend to report that they do more revising while writing than after having completed a draft (NAEP & ETS, 1986). Also, Bridwell (1980) found that 12th graders made more changes while writing than between-draft changes. However, others found that older expert and inexpert individuals and 6th graders made more between-draft changes than in-process ones (Faigley & Witte, 1981; Fitzgerald & Markham, 1987). Reasons for some discrepant results could again be attributed to different methods of counting.

What kinds of revisions are made. Overwhelming evidence supports the belief that writers at various ages and various levels of competence mainly make surface and mechanical revisions, often revealing a view of revision as proofreading (Bridwell, 1980; Crowley, 1977; Faigley & Witte, 1981; Fitzgerald & Markham, 1987; Freedman & Pringle, 1980; Graves, 1979; Kane, 1983; Monahan, 1982; NAEP, 1977; NAEP & ETS, 1986; Ramig, 1982; Scardamalia & Bereiter, 1986; Sommers, 1980). Only two contradictory reports were found. Ash (1983) reported that fewer than one third of the revisions made by 8th, 10th, and 12th graders were surface changes, and Hawisher (1987) found advanced college freshmen made slightly fewer surface than meaning changes.

Surface revisions predominate, but there is also a plethora of evidence that suggests that older and/or more competent writers tend to do more revising for meaning and make more sentence- and theme-level changes than do younger and/or less competent writers (Ash, 1983; Butler-Nalin, 1984; Crowhurst, 1983; Faigley & Witte, 1981; Lehrer & Comeaux, 1987; Levin, Riel, Rowe, & Boruta, 1985; Monahan, 1983; NAEP & ETS, 1986; Sommers, 1980; Stallard, 1974). A striking example of the age-related increasing focus on meaning-related revision was reported by Faigley and Witte (1981). Expert professional writers made one meaning-related revision for every two surface changes; advanced college student writers made one for every three; and inexperienced college student writers made one for every seven.

Finally, limited evidence suggests that writers make different kinds of changes when they revise their own texts than when they revise others' texts. Bartlett

(1982) found, for example, that children in fourth through seventh grades detected syntactic problems and referential ambiguities more often in others' texts.

The Relationship of Revision to Quality of Writing

Generally, for high school age and older or more skilled writers, revisions appear to improve the quality of compositions (Ash, 1983; Bamberg, 1978; Bracewell, Scardamalia, & Bereiter, 1978; Bridwell, 1980). Similarly, students judged higher in writing achievement tend to report that they do more revising (NAEP & ETS, 1986). Two exceptions were found where no relationship emerged between degree of revision or amount of revision and quality for high school and college freshman writers (Beach, 1979; Hawisher, 1987). Also, for older writers, higher quality writing tends to be associated with a wider variety of types of revisions (Bridwell, 1980), revisions beyond the word level (Maynor, 1982), and macrostructure changes (Hawisher).

In contrast, some limited evidence suggests that for younger or less competent college writers, revision may not have a positive effect on quality. Bracewell, Scardamalia, and Bereiter (1978) found no relationship for fourth graders, and eighth graders' changes *reduced* the quality of drafts. Perl (1978) found that revisions of unskilled college writers often resulted in worse drafts.

Some intervention research suggests that instructional support or feedback may enhance the link between revision and quality. Buxton (1959) found that a group of college freshman who received feedback and then revised outscored others on grades on their essays; and two other sets of researchers (Cohen & Scardamalia, 1983; Fitzgerald & Markham, 1987) reported that after instruction designed to enhance revision efforts, sixth-grade students' second drafts were judged higher in quality than first drafts. One other intervention study (Scardamalia & Bereiter, 1983), however, found no improvement in overall quality.

Intervention Research

As a preface to a synthesis of findings of intervention research, it is perhaps useful to note that some research indicates that little emphasis is placed on revision in writing in American public schools. Results of several studies suggest that high school students are seldom asked to revise their work (Applebee, 1981; Hoetker & Brossell, 1979; Pipman, 1984; Shaw, Pettigrew, & van Nostrand, 1983; Squire & Applebee, 1968). Squire and Applebee, for example, found, in a survey of 106 high schools of good reputation, that only about 12% of the high schools had students revise their writing completely. Applebee (1981) found that just under 30% of 134 high school teachers (participating in a national survey) reported they regularly required students to write more than one draft of a writing assignment; most of the 30% were English teachers. Similarly, in a sample of 1,129 college freshmen, more than 75% said they had seldom or never been asked to revise papers in their high school English classes (Hoetker & Brossell, 1979). Two reports indicated that in elementary and secondary English classrooms, only from 3% to 6% of the writing time and class time, respectively, was allocated to revision. In contrast, Carter (1983) found considerably more emphasis placed on revision in advanced college composition classes, with faculty reporting 10% to 30% of class time devoted to revision.

The total number of intervention studies is small. However, several different

types of interventions have been designed to enhance revision efforts. Broad categories of interventions are: procedural support, direct instruction in the process of revision, teacher or peer feedback, and giving directions. These broad categories do overlap somewhat. For example, procedural support may include teacher or peer feedback and/or directions to revise. In the present review, studies have been grouped according to the predominant paradigm used.

Research on procedural support and direct instruction mainly involves younger students, whereas research on feedback and directions to revise mainly involves older students. On the whole, procedural support, direct instruction, and feedback from others (particularly peers) have tended to produce positive results, whereas giving directions to revise has yielded mixed findings.

Effects of procedural support. Procedural support scaffolds writers by cuing them about their products or about aspects of revision. Four types of facilitation may be identified: procedural facilitation, naturalistic classroom support, student self-assessment, and microcomputer prompting.

Procedural facilitation, developed by Scardamalia and Bereiter (1983, 1985) (defined earlier in this paper in the section "Simulation-by-Intervention Method"), has been effective in (a) helping elementary grade children to make appropriate evaluations of their work as compared to evaluations made by professionals (Scardamalia & Bereiter, 1983, 1985), (b) eliciting higher level revisions than normal from elementary grade children (Scardamalia & Bereiter, 1983, 1985), and (c), in at least one case, enhancing overall quality of children's texts, as well as quality of individual revisions (Cohen & Scardamalia, 1983).

Naturalistic classroom support refers to intervention procedures such as questioning, conferencing, having dialogues, and providing lots of opportunity to write and revise. It is summed up well by Calkins (1980a): "Learning to revise is an organic, personal process. It is not unlike learning to think, question, and research. Children will grow into the writing process if given the opportunity to experiment and the encouragement to fail and try again" (p. 44). Reports of effects of naturalistic classroom activities in primary grades suggest that such external support can substantially enhance children's revision activity (Calkins, 1979, 1980a, 1980b; Graves, 1978).

Student self-assessment intervention was used by Beach and Eaton (1984). They developed a self-assessment form listing questions about goals and problems in achieving goals for specific parts of students' drafts. Engineered as a device to help students learn to think about revising as a problem-solving process, training and practice in using the form affected college freshmen's judgments of problems but did not affect their ability to describe strategies for revisions.

Finally, microcomputer programs designed to prompt or enhance revision activity may be useful for helping children, technical writers, and college students to learn about aspects of revision (Daiute, 1983, 1985, 1986; Daiute & Kruidenier, 1985; Frase, Kiefer, Smith, & Fox, 1985; Kiefer & Smith, 1984; McCutchen, Hull, & Smith, 1987). Prompting programs may increase revision activity and efficiency over writing with word processors or pens with no prompts (Daiute, 1985, 1986; Daiute & Kruidenier; McCutchen et al.), and they may lead to more substitution, consolidation, and meaningful changes (Daiute, 1985; Daiute & Kruidenier). However, there is variability in the effectiveness of prompting programs. Case studies of two 11- and 12-year-olds hint that computer prompting may facilitate revision

for less skilled writers but inhibit certain types of revision activity for better writers (Daiute, 1985). Such a finding, albeit tentative, leads to the speculation that the effectiveness of word processing prompting programs may lie not so much in facilitation of physical factors involved in revision, that is, in carrying out desired operations, as in facilitation of cognitive factors, such as identifying problem spots. Better writers may be more capable of problem identification than poorer writers; prompting, therefore, might not help them much, or could even be a hindrance to an already smooth-running revision routine.

At least two studies showed evidence of transfer of learning about revision or editing from microcomputer programs to pen-and-paper writing (Kiefer & Smith, 1984; Woodruff, Bereiter, & Scardamalia, 1981). However, learning the skills from microcomputer programs may have no advantage over learning them from regular classroom instruction (Kiefer & Smith, 1984).

A limited amount of research suggests that children and adult users prefer prompting or text analysis programs which aid word- and sentence-level changes, rather than ones that aid revision of larger text features such as organization (Daiute, 1983; Gingrich, 1982).

Effects of direct instruction. Direct instruction attempts to tell about, and show writers, what the revision process is and how to revise. Direct instruction in revision research appears to be rare, but at least one study revealed beneficial effects of teaching sixth graders about the compare/diagnose/operate process of revision (Fitzgerald & Markham, 1987). The instruction enhanced children's ability to identify discrepancies between goals and intentions, their knowledge of what could be changed in their texts, their knowledge of how to make desired changes, and their ability to make actual changes. Also, quality of revised compositions was judged higher than first drafts.

Effects of teacher or peer feedback and effects of directions to revise. Some studies investigate both feedback and directions to revise (i.e., simply telling students to revise [e.g., Buxton, 1959; Hillocks, 1982]), and some combine these two variables with others (e.g., Hillocks). To simplify presentation, effects of feedback and of directions to revise are separated here as much as possible.

Several general conclusions may be drawn about feedback:

1. Findings tend to suggest that feedback can enhance revision. Although Vukelich (1986) found only a weak relationship between peer sharing and 7-year-olds' text revisions, a handful of reports indicate that teacher or peer feedback can enhance revision for writers in the primary grades through high school, especially if the feedback is focused and part of a wider instructional program (Benson, 1979; Gere & Stevens, 1985; Graves, 1979; Hillocks, 1982; Kamler, 1980; Sperling & Freedman, 1987).

2. Research with high school and older students suggests that feedback to writers from others, followed by subsequent revision, also positively affects quality of writing (Dudenhefer, 1976; Maize, 1952; McColly & Remstad, 1963).

3. For high school writers, peer feedback may be more effective than teacher feedback for improving quality (Karegianes, Pascarella, & Pflaum, 1980), and teacher feedback may be better than self-evaluation or no evaluation (Beach, 1979).

Results of research on effectiveness of giving instructions to high school and college students to revise are mixed and may be summarized as follows:

1. Though Hillocks (1982) found that practice in revising can affect performance on subsequent new writing tasks, Hansen (1978) and Newman (1982a, 1982b) found no such effects.

2. Similarly, Matsuhashi and Gordon (1985) found that specific cues to revise (e.g., directions to add material) affected revision efforts, whereas Newman (1982a, 1982b) found no effect of directions to revise on revision skills.

Finally, teacher feedback, comments, and/or suggestions combined with requests to revise may enhance revision efforts (Arnold, 1963; Buxton, 1959; West, 1967).

Miscellaneous Findings

A few studies have addressed notable issues not subsumed under topics summarized so far. The issues are gender effects, genre or topic effects, the relationship between reading ability and revision, and effects of using word processors (with no accompanying prompting or text evaluation program). Briefly, the studies found the following:

1. Females tend to revise more extensively than males (Beach, 1979; Bridwell, 1980; NAEP, 1977).

2. Effects of genre or topic are unclear. Crowhurst (1983) found, for 14 good and 14 average writers in grades 5, 7, and 11, that neither amount nor type of revision varied across expressive and persuasive compositions. But Butler-Nalin (1984) reported that 15 9th- and 11th-grade students revised more for topics that required theorizing or analysis than for topics that required reporting or summarizing. The students revised social science papers more than science papers, and English papers most of all.

3. Some evidence supports a relationship between reading ability and selected aspects of the revision process. Beach (1984) found a significant positive relationship between students' reading ability and the degree of students' specificity regarding their goals and intentions for the composition. No relationships existed between reading ability and students' specificity regarding problems in fulfilling their intentions, students' specificity regarding their own predictions for revisions on a future draft, or the degree of revision actually carried out.

4. Whether using word processors (with no accompanying prompting or text evaluation program) affects amount of revision is unclear. Some reports indicate that junior high students and adults revise more with word processors than with pens or typewriters (Bridwell, Sirc, & Brooke, 1985; Collier, 1983; Daiute, 1986; Gould, 1980; Levin, Riel, Rowe, & Boruta, 1985), and some indicate less revision with word processors (Harris, 1985; Hawisher, 1987). More consistent results emerge, however, for effects of using word processors on the kind of revisions made; more surface revisions tend to be made with word processors, as compared with conventional methods (Bridwell, Sirc, & Brooke, 1985; Daiute, 1986; Gould, 1980), and more expanded revising may occur with pens (Daiute, 1986; Harris, 1985). Only one study showed no effect on type of revisions made (Hawisher, 1987). Furthermore, a few researchers studying revision with word processors report no simultaneous effect on quality of writing (Collier, 1983; Gould; Hawisher). Only Daiute (1986) found slight improvement in quality from the first to the last drafts written using word processors.

Conclusions, Limitations, and Recommendations

Research on revision in writing is at a pivotal point. A view of revision that begins to capture its potential complexity is developing. Research has documented the recursive and problem-solving nature of revision and has described how much writers revise, when they revise, and what kinds of revision operations they make. However, work on the cognitive aspects of the revision process is scant. Issues of how and when writers learn through revision remain virtually unexplored. Little is known about the circumstances under which the revision process is related to judgments of quality of writing, and intervention studies are just beginning to provide insight into ways of nurturing the development of revision knowledge and abilities.

One key factor in the productiveness of new research is the extent to which future studies center on a common detailed definition of revision. Though tacit consensus has been gained about views of revision, to date stated definitions are rare. A widely used, broad, and clear definition of revision is essential for the development of research and theory.

A second factor in the productiveness of new research is the degree to which researchers can invent new methodologies and research designs, or better utilize existing ones to tap the cognitive aspects of revision. At least six features of research methodology and design might be especially important to consider in future studies.

1. A crucial design factor is likely to be the extent to which new research examines revision in a broader context than it has in the past. Two earlier findings suggest one way in which revision research might take on more breadth. One is the glimmer of a developmental pattern in the relationship between revision and quality of writing, with revision activity of older and/or more competent writers tending to be positively associated with quality of compositions, but revision activity of younger and/or less competent writers having no relationship (or a negative one) with quality. The other finding is that older, more competent writers make more substantive and meaning changes than do younger, less competent ones. When the two findings are linked, it appears possible that the relationship between revision activity and quality may be mediated by the types of revision that are made. Most likely, the critical aspect of revision with regard to quality is not merely how much is done or how many revisions are made, but what is done or which revisions are made. The inescapable conclusion is that more research might be shaped to enlighten our knowledge about writers' revisions in relation to "what's needed," rather than merely describing revision operations that are done.

Similarly, many revision studies have attempted to investigate revision activity without significant regard for the integration of the revision process into the total act of writing. A few investigators, for example, have attempted either to ease aspects of the writing/revision process or to teach a way to think about revising without specification of the writers' knowledge of formal characteristics of writing (such as sentence structure or syntax). The revision process itself is embedded in other subprocesses of writing and cannot be divorced from such features as knowledge of the content of what is being written and knowledge of characteristics of what makes a text a "good" text. Our understanding of revision might be

dramatically enhanced if studies could be formulated that could account for and/or examine revision as it is encased in, or linked to, such knowledge.

2. Few studies have examined revisions of adult writers other than college students, professional writers, or English teachers. Revision activity of other adults—especially adults in occupations where functional writing is prevalent—would be enlightening.

3. The predominant method used so far to study revision has been coding schemes, which have most often focused on revision operations or products, though sometimes they have been used to gain insight into writers' minds. To gain a fuller understanding of revision, other procedures might be further explored, or new procedures developed, to provide more insight into how and when the revision process happens and how and when it breaks down (Faigley, Cherry, Jolliffe, & Skinner, 1985).

4. Methodologies have so far restricted insights to revision as it occurs while or after the pen meets paper (Witte, 1985). Techniques should be explored which hold potential for garnering information about revision that occurs before pen meets paper.

5. No studies that were located used multiple samples of writing in the same genre, and effects of genre are often ignored. Revision is likely to be linked to content of the composition. It will be important to raise further questions about the generalizability of findings about revision across multiple samples and genres (Clark, 1973; Fulkerson, 1978).

6. Many studies that counted revision operations did not take length of writing sample into account and/or ignored issues of reliability and validity of the variables investigated. Length of writing sample may be correlated with both amount and kind of revision operations and with writers' ability to deploy revision (Fisher, 1981). Also, high reliability is essential to establishing the veracity of findings.

A third, and perhaps most important, factor in the long-range significance of research on revision may be tied to researchers' ability to raise questions about how revision helps people to learn. Expert and well-known authors testify that they learn what they are trying to say as they write and revise (Lowenthal, 1980; Murray, 1978a, 1978b; Odell, 1980). Revision may be a powerful tool for mental development (Freedman, 1985), but today very little is known about how or when revision aids learning.

Two theoretical outlooks, currently being developed by reading and writing researchers and by psychologists interested in knowledge acquisition, may inspire new directions in thinking about the role of revision in learning. One outlook involves exploration of the parallels between revision in writing and revision in reading (Kucer, 1985; Tierney & Pearson, 1985). Revision in reading refers to mental rebuilding or reconstruction of models of meaning and can entail activities such as rereading, annotating texts with comments, and questioning while reading. An important contribution of identification of parallels in revision processes in reading and writing may be that it can lead researchers to identification of a common research space. For example, current problem-solving models of writing appear to be similar to, but more extensively developed than, earlier problem-solving views of reading (cf. Olshavsky, 1976–1977); new problem-solving models of revision in writing might more fully inform understanding of revision processes in reading. Separate communities of researchers may learn from each other and

may begin to pursue more generic research issues, such as identification of the conditions under which reconstructive thought takes place, which in turn can inform the specific domains of reading and writing.

A second outlook addresses how knowledge is acquired or changed. Vosniadou and Brewer (1987) recently proposed several mechanisms for knowledge restructuring. At least one of them seems especially relevant to learning through revision in writing, that is, Socratic dialogue. Socratic dialogue, Vosniadou and Brewer say, is likely to enhance individuals' awareness of inconsistencies or anomalies in their knowledge change. Notice that the language used to discuss the restructuring phenomenon, that is, *inconsistencies* and *anomalies*, is reminiscent of language used by writing researchers to explain aspects of a problem-solving model of revision, that is, revisers identify *discrepancies* between intentions and instantiated text. Perhaps something like an internal Socratic dialogue occurs when writers learn or reconstruct meaning through writing. Maybe teachers and peers who support writers through questioning and commenting on their written pieces are sometimes actually engaging in Socratic-like dialogue which leads the writer to new visions. The study of how knowledge is restructured might inform theories of how revision in writing may shape writers' insights.

Many new lines of inquiry could be developed by linking revision in writing research with other theoretical developments. Perhaps such inquiry could lead to a better understanding of the revision process, the circumstances under which revision aids learning, and ways we might better cultivate the development of revision abilities.

References

Applebee, A. N. (1981). *Writing in the secondary school: English and the content areas*. Urbana, IL: National Council of Teachers of English.

Aristotle. (1984). (W. Rhye Roberts, Trans.). *Rhetoric*. New York: Modern Library.

Arnold, L. V. (1963). Effects of frequency of writing and intensity of teacher evaluation upon performance in written composition of tenth grade students. *Dissertation Abstracts, 24*, 1021A.

Ash, B. H. (1983). Selected effects of elapsed time and grade level on the revisions in eighth, tenth, and twelfth graders' writing. *Dissertation Abstracts, 43* (12), 3830A.

Bamberg, B. (1978). Composition instruction does make a difference: A comparison of college freshmen in regular and remedial English courses. *Research in the Teaching of English, 12*, 47–59.

Bartlett, E. J. (1982). Learning to revise. In M. Nystrand (Ed.), *What writers know* (pp. 345–363). New York: Academic Press.

Beach, R. (1976). Self-evaluation strategies of extensive revisers. *College Composition and Communication, 27*, 160–164.

Beach, R. (1979). The effects of between-draft teacher evaluation versus student self-evaluation on high school students' revision of rough drafts. *Research in the Teaching of English, 13*, 111–119.

Beach, R. (1984, April). *The effect of reading ability on seventh graders' narrative writing*. Paper presented at the annual meeting of the American Educational Research Association, New Orleans.

Beach, R., & Eaton, S. (1984). Factors influencing self-assessing and revising by college freshmen. In R. Beach & L. Bridwell (Eds.), *New directions in composition research* (pp. 149–170). New York: Guilford Press.

Benson, N. L. (1979). The effects of peer feedback during the writing process on writing

performance, revision behavior, and attitude toward writing. *Dissertation Abstracts, 40* (04), 1987a.

Bereiter, C., & Scardamalia, M. (1983). Levels of inquiry in writing research. In P. Mosenthal, L. Tamor, & S. A. Walmsley (Eds.), *Research on writing: Principles and methods* (3–25). New York: Longman.

Bracewell, R. J. (1980, April). *The ability of primary school students to manipulate language form when writing*. Paper presented at the annual meeting of the American Educational Research Association, Boston.

Bracewell, R. J. (1987, April). *Semantic and textual constraints students use in revising their writing*. Paper presented at the annual meeting of the American Educational Research Association, Washington, DC.

Bracewell, R. J., Bereiter, C., & Scardamalia, M. (1979, April). *A test of two myths about revision*. Paper presented at the annual meeting of the American Educational Research Association, San Francisco.

Bracewell, R. J., Bereiter, C., & Scardamalia, M. (1980, April). *How beginning writers succeed and fail in making written arguments more convincing*. Paper presented at the annual meeting of the American Educational Research Association, Boston.

Bracewell, R. J., Scardamalia, M., & Bereiter, C. (1978). *The development of audience awareness in writing*. (ERIC Document Reproduction Service No. ED 154 433)

Bridwell, L. (1979). Revising processes in twelfth grade students' transactional writing. *Dissertation Abstracts, 40*(11), 5765 A.

Bridwell, L. S. (1980). Revising strategies in twelfth grade students' transactional writing. *Research in the Teaching of English, 14*, 197–222.

Bridwell, L., Sirc, G., & Brooke, R. (1985). Revising and computing: Case studies of student writers. In S. W. Freedman (Ed.), *The acquisition of written language: Response and revision* (pp. 172–194). Norwood, NJ: Ablex.

Britton, J., Burgess, T., Martin, N., McLeod, A., & Rosen, H. (1975). *The development of writing abilities (11–18)*. London: Macmillan Education.

Burtis, P. J., Bereiter, C., Scardamalia, M., & Tetroe, J. (1983). The development of planning in writing. In G. Wells & B. M. Kroll (Eds.), *Explorations in the development of writing* (pp. 153–174). Chichester, England: Wiley.

Butler-Nalin, K. (1984). Revision patterns in students' writing. In Arthur N. Applebee (Ed.), *Contexts for learning to write: Studies for secondary school instruction* (pp. 121–215). Norwood, NJ: Ablex.

Buxton, E. W. (1959). An experiment to test the effects of writing frequency and guided practice upon student mechanics skill in writing expression. *Alberta Journal of Educational Research, 5*, 91–99.

Calkins, L. M. (1979). Andrea learns to make writing hard. *Language Arts, 56*, 569–576.

Calkins, L. M. (1980a). The craft of writing. *Teacher, 98*, 41–44.

Calkins, L. M. (1980b). Notes and comments: Children's rewriting strategies. *Research in the Teaching of English, 14*, 331–341.

Calkins, L. M. (1982). *A study of children's rewriting*. Final Report for NCTE Research Foundation Project No. 80:11. (ERIC Document Reproduction Service No. ED 229 750).

Carter, R. D. (1983, March). *A survey of revision practices in today's advanced composition course*. Paper presented at the annual meeting of the Conference on College Composition and Communication, Detroit. (ERIC Document Reproduction Service No. ED 229 794)

Cattani, C., Scardamalia, M., & Bereiter, C. (1981). *Facilitating diagnosis in student writing*. Unpublished manuscript, Ontario Institute for Studies in Education, Toronto.

Clark, H. H. (1973). The language-as-fixed-effect fallacy: A critique of language statistics in psychological research. *Journal of Verbal Learning and Verbal Behavior, 12*, 335–359.

Clark, H. H. (1977). Inferences in comprehension. In D. LaBerge & S. J. Samuels (Eds.), *Basic processes in reading: Perception and comprehension* (pp. 243–262). Hillsdale, NJ: Erlbaum.

Cohen, E., & Scardamalia, M. (1983, April). *The effects of instructional intervention in the revision of essays by grade six children.* Paper presented at the annual meeting of the American Educational Research Association, Montreal.

Collier, R. M. (1983, May). The word processor and revision strategies. *College Composition and Communication, 34*(2), 149–155.

Cowley, M. (Ed.). (1958). *Writers at work: The Paris Review interview* (Vol. 1). New York: Viking.

Crothers, E. J. (1978). Inference and coherence. *Discourse Processes, 1*, 51–71.

Crothers, E. J. (1979). *Paragraph structure inference.* Norwood, NJ: Ablex.

Crowhurst, M. (1983). *Revision strategies of students at three grade levels: Final report.* Vancouver: Educational Research Institute of British Columbia. (ERIC Document Reproduction Service No. ED 283 009)

Crowley, S. (1977). Components of the composing process. *College Composition and Communication, 28*(2), 166–169.

Daiute, C. (1983, April). *The effects of automatic prompting on young writers.* Paper presented at the annual meeting of the American Educational Research Association, Montreal.

Daiute, C. (1985). Do writers talk to themselves? In S. Freedman (Ed.), *The acquisition of written language: Response and revision* (pp. 133–139). Norwood, NJ: Ablex.

Daiute, C. (1986, May). Physical and cognitive factors in revising: Insights from studies with computers. *Research in the Teaching of English, 20*(2), 141–159.

Daiute, C., & Kruidenier, J. (1985). A self-questioning strategy to increase young writers' revising processes. *Applied Psycholinguistics, 6*, 307–318.

de Beaugrande, R. (1984). *Text production: Toward a science of composition.* Norwood, NJ: Ablex.

Della-Piana, G. (1978). Research strategies for the study of revisions processes in writing poetry. In C. R. Cooper & L. Odell (Eds.), *Research on composing: Points of departure* (pp. 105–134). Urbana, IL: National Council of Teachers of English.

Dembo, L. S., & Pondrom, C. M. (1972). *The contemporary writer: Interviews with sixteen novelists and poets.* Madison: University of Wisconsin Press.

Dudenhefer, J. P., Jr. (1976). An experimental study of two techniques of composition revision in a developmental English course for technical students. *Dissertation Abstracts, 36*(11), 7230A.

Emig, J. (1971). *The composing processes of twelfth graders.* (NCTE Research Report No. 13.X). Urbana, IL: National Council of Teachers of English.

Faigley, L., Cherry, R. D., Jolliffe, D. A., & Skinner, A. M. (1985). *Assessing writers' knowledge and processes of composing.* Norwood, NJ: Ablex.

Faigley, L., & Skinner, A. (1982). *Writer's processes and writer's knowledge: A review of research.* (Tech. Rep. No. 6). Austin: University of Texas.

Faigley, L., & Witte, S. (1981). Analyzing revision. *College Composition and Communication, 32*, 400–414.

Faigley, L., & Witte, S. P. (1984). Measuring the effects of revisions on text structure. In R. Beach & L. Bridwell (Eds.), *New directions in composition research* (pp. 95–108). New York: Guilford Press.

Fisher, J. E. (1981). *The interference of mechanical errors in the revision of compositions by grade six children.* Unpublished master's thesis, Ontario Institute for Studies in Education, Toronto.

Fitzgerald, J., & Markham, L. (1987). Teaching children about revision in writing. *Cognition and Instruction, 4*(1), 3–24.

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

Flower, L., & Hayes, J. A. (1981a). A cognitive process theory of writing. *College Composition and Communication, 32*, 365–387.

Flower, L., & Hayes, J. R. (1981b). Plans that guide the composing process. In C. H. Frederiksen & J. F. Dominic (Eds.), *Writing: The nature, development, and teaching of written communication: Volume 2. Writing: Process, development, & communication.* Hillsdale, NJ: Erlbaum.

Flower, L., Hayes, J. R., Carey, L., Schriver, K., & Stratman, J. (1986). Detection, diagnosis, and the strategies of revision. *College Composition and Communication, 37*(1), 16–55.

Frase, L. T., Kiefer, K. E., Smith, C. R., & Fox, M. L. (1985). Theory and practice in computer-aided composition. In S. W. Freedman (Ed.), *The acquisition of written language: Response and revision* (pp. 195–212). Norwood, NJ: Ablex.

Freedman, A., & Pringle, I. (1980). *The writing abilities of a representative sample of grade 5, 8, and 12 students: The Carleton Writing Project, Part II* (Final Report). Carleton (Ontario) Board of Education. (ERIC Document Reproduction Service No. ED 217 413)

Freedman, S. W. (Ed.). (1985). *The acquisition of written language: Response and revision.* Norwood, NJ: Ablex.

Fulkerson, R. (1978). Some cautions about pedagogical research. *College English, 40*, 463–466.

Galbraith, David. (1980). The effect of conflicting goals on writing: A case study. *Visible Language, 14*(4), 364–375.

Gentry, L. A. (1980a). *A new look at young writers: The writing-process research of Donald Graves* (Technical Note No. 2–80/07). Los Alamitos, CA: Southwest Regional Laboratory for Educational Research and Development. (ERIC Document Reproduction Service No. ED 192 354)

Gentry, L. A. (1980b). *Textual revision: A review of the research* (Technical Note No. 2–80/11). Los Alamitos, CA: Southwest Regional Laboratory for Educational Research and Development. (ERIC Document Reproduction Service No. ED 192 355)

Gere, A. R., & Stevens, R. S. (1985). The language of writing groups: How oral response shapes revision. In S. W. Freedman (Ed.), *The acquisition of written language: Response and revision* (pp. 85–105). Norwood, NJ: Ablex.

Gingrich, P. (1982). Writer's Workbench: Studies of users. *29th International Technical Communications conference proceedings.* Piscataway, NJ: Bell Laboratories.

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.

Gould, J. D. (1980). Experiments on composing letters: Some facts, some myths, and some observations. In L. W. Gregg & E. R. Steinberg (Eds.), *Cognitive process in writing* (pp. 97–127). Hillsdale, NJ: Erlbaum.

Graves, D. H. (1975). An examination of the writing processes of seven year old children. *Research in the Teaching of English, 9*, 227–241.

Graves, D. H. (1978). *Balance the basics: Let them write.* New York: Ford Foundation.

Graves, D. H. (1979, March). What children show us about revision. *Language Arts, 56*, 312–319.

Graves, D. H. (Ed.). (1981a). *A case study observing the development of primary children's composing, spelling, and motor behaviors during the writing process report.* (NIE Grant No. G–78–0174). Durham: University of New Hampshire. (ERIC Document Reproduction Service ED 218 653)

Graves, D. H. (1981b). Research update: Writing research for the eighties: What is needed. *Language Arts, 58*, 197–206.

Graves, D. H. (1983). *Writing: Teachers and children at work.* Exeter, NH: Hernemann.

Graves, D. H., & Murray, D. M. (1980). Revision: In the writer's workshop and in the classroom. *Journal of Education, 162*, 38–56.

Halliday, M. A. K., & Hasan, R. (1976). *Cohesion in English.* London: Longman.

Hansen, B. (1978). Rewriting is a waste of time. *College English, 39*, 956–960.

Harris, J. (1985). Student writers and word processing: A preliminary evaluation. *College Composition and Communication, 36*, 323–330.

Hawisher, G. E. (1987). The effects of word processing on the revision strategies of college freshmen. *Research in the Teaching of English, 21*(2), 145–159.

Hayes, J. R., & Flower, L. S. (1980a). Identifying the organization of writing processes. In L. W. Gregg & E. R. Steinberg (Eds.), *Cognitive processes in writing* (pp. 4–30). Hillsdale, NJ: Erlbaum.

Hayes, J. R., & Flower, L. S. (1980b). Writing as problem solving. *Visible Language, 14*, 388–399.

Hayes, J. R., & Flower, L. S. (1983). Uncovering cognitive processes in writing: An introduction to protocol analysis. In P. Mosenthal, L. Tamor, & S. A. Walmsley (Eds.), *Research on writing: Principles and methods* (pp. 207–220). New York: Longman.

Hildick, E. W. (1965). *Word for word: The rewriting of fiction*. London: Faber and Faber.

Hillocks, G. (1982, October). The interaction of instruction, teacher comment, and revision in teaching the composing process. *Research in the Teaching of English, 16*, 261–278.

Hodges, K. (1982). A history of revision: Theory versus practice. In R. A. Sudol (Ed.), *Revising: New essays for teachers of writing* (pp. 24–42). Urbana, IL: ERIC Clearinghouse on Reading and Communication Skills, National Institute of Education and National Council of Teachers of English.

Hoetker, J., & Brossell, G. (1979). Who (if anyone) is teaching them writing and how? *English Journal, 68*, 19–25.

Hull, G. A. (1984, April). *The editing process in writing: A performance study of experts and novices*. Paper presented at the annual meeting of the American Educational Research Association, New Orleans.

Humes, A. (1983). Research on the composing process. *Review of Educational Research, 53*(2), 201–216.

Kamler, B. (1980). One child, one teacher, one class: The story of one piece of writing. *Language Arts, 57*, 680–693.

Kane, J. H. (1983, April). *Computers for composing*. Paper presented at the annual meeting of the American Educational Research Association, Montreal. (ERIC Document Reproduction Service No. ED 230 978)

Karegianes, M. L., Pascarella, E. T., & Pflaum, S. W. (1980). The effects of peer editing on the writing proficiency of low-achieving tenth grade students. *Journal of Educational Research, 73*(2), 203–207.

Kiefer, K., & Smith, C. (1984). Improving students' revising and editing: The Writer's Workbench system at Colorado State University. In W. Wresch (Ed.), *A writer's tool: The computer in composition instructions* (pp. 65–82). Urbana, IL: National Council of Teachers of English.

Kintsch, W. (1974). *The representation of meaning in memory*. Hillsdale, NJ: Erlbaum.

Kintsch, W., & van Dijk, T. A. (1978). Toward a model of text comprehension and production. *Psychological Review, 85*, 363–394.

Kroll, B. M. (1978). Cognitive egocentrism and the problem of audience awareness in written discourse. *Research in the Teaching of English, 12*, 269–281.

Kucer, S. (1985, December). *The parallel role of revision in reading and writing*. Paper presented at the annual meeting of the National Reading Conference, San Diego, CA.

Lehrer, R., & Comeaux, M. (1987, April). *A developmental study of the effects of goal constraints on composition*. Paper presented at the annual meeting of the American Educational Research Association, Washington, DC.

Levin, J. A., Riel, M. M., Rowe, R. D., & Boruta, M. J. (1985). Muktuk meets Jacuzzi: Computer networks and elementary school writers. In S. W. Freedman (Ed.), *The acquisition of written language: Response and revision* (pp. 160–171). Norwood, NJ: Ablex.

Lowenthal, D. (1980). Mixing levels of revision. *Visible Language, 14*(4), 383–387.
Lyman, R. L. (1929). *Summary of investigations relating to grammar, language, and composition*. Chicago: The University of Chicago.
Maize, R. C. (1952). *A study of two methods of teaching English composition to retarded college freshman*. Unpublished doctoral dissertation, Purdue University, West Lafayette, IN.
Markham, L. R. (1983, November). *Revision in first graders' writing: Learning to communicate with yourself*. Paper presented at the annual meeting of the National Council of Teachers of English, Denver.
Matsuhashi, A., & Gordon, E. (1985). Revision, addition, and the power of the unseen text. In S. Freedman (Ed.), *The acquisition of written language: Response and revision* (pp. 226–249). Norwood, NJ: Ablex.
Maynor, L. C. (1982). An investigation of the revising practices of college freshman writers. *Dissertation Abstracts, 43*(8), 2543A.
McColly, W., & Remstad, R. (1963). *Comparative effectiveness of composition skills learning activities in the secondary school*. U.S. Educational Resources Information Center. (ERIC Document Reproduction Service No. ED 003 279)
McCutchen, D., Hull, G. A., & Smith, W. L. (1987). Editing strategies and error correction in basic writing. *Written Communication, 4*(2), 139–154.
Meyer, B. (1975). *The organization of prose and its effect upon memory*. Amsterdam: North Holland.
Monahan, B. D. (1982). *Revision strategies of basic and competent writers as they write for different audiences*. (ERIC Document Reproduction Service No. ED 229 756)
Murray, D. (1978a). Internal revision: A process of discovery. In C. Cooper and L. Odell (Eds.), *Research on composing: Points of departure* (pp. 85–103). Urbana, IL: National Council of Teachers of English.
Murray, D. M. (1978b, October). Teach the motivating force of revision. *English Journal, 67*, 56–60.
National Assessment of Educational Progress. (1977). *Write/rewrite: An assessment of revision skills: Selected results from the second national assessment of writing*. (ERIC Document Reproduction Service No. ED 141 826)
National Assessment of Educational Progress & Educational Testing Service. (1986). *The writing report card: Writing achievement in American schools*. Princeton, NJ: National Assessment of Educational Progress.
Newman, J. M. (1982a). The effects of formal revision in an enriched composing environment on composing improvement of college-bound high school seniors. *Dissertation Abstracts, 43*(11), 3575A.
Newman, J. M. (1982b). *The effect of formal revision on improving writing skills*. (ERIC Document Reproduction Service No. ED 234 380).
Nold, E. W. (1979). Alternatives to mad-hatterism. In D. McQuade (Ed.), *Linguistics, stylistics, and the teaching of composition* (pp. 103–117). Akron, OH: University of Akron.
Nold, E. W. (1981). Revising. In C. H. Frederiksen & J. F. Dominic (Eds.), *Writing: The nature, development and teaching of written communication* (pp. 67–79). Hillsdale, NJ: Erlbaum.
Odell, L. (1980). Business writing: Observations and implications for teaching composition. *Theory Into Practice, 19*(3), 225–232.
Olshavsky, J. E. (1976–1977). Reading as problem solving: An investigation of strategies. *Reading Research Quarterly, 12*, 654–674.
Perl, S. (1978). Five writers writing: Case studies of the composing processes of unskilled college writers. *Dissertation Abstracts, 39*(8), 4788A.
Perl, S. (1979). The composing processes of unskilled college writers. *Research in the Teaching of English, 13*(4), 317–336.

Perl, S. (1980, December). Understanding composing. *College Composition and Communication, 31*, 363–369.

Pianko, S. (1977). The composing acts of college freshman writers: A description. *Dissertation Abstracts, 38*(7), 3983A.

Pipman, M. H. (1984, August). The amount and nature of composition instruction in two secondary English classrooms. *Dissertation Abstracts, 45*(2), 486A.

Plimpton, G. G. (1963). *Writers at work: The Paris Review interviews* (2nd series). New York: Viking.

Plimpton, G. G. (Ed.). (1967). *Writers at work: The Paris Review interviews* (3rd series). New York: Viking.

Plimpton, G. G. (Ed.). (1976). *Writers at work: The Paris Review interviews* (4th series). New York: Viking.

Ramig, J. R. D. (1982). An investigation of the revision practices of competent student writers writing research papers in a freshman composition course at a community college. *Dissertation Abstracts, 43*(10), 3208A.

Rohman, D. G. (1965). Pre-writing: The stages of discovery in the writing process. *College Composition and Communication, 16*, 106–112.

Rohman, D. G., & Wlecke, A. O. (1964). *Pre-writing: The construction and application of models for concept formation in writing*. East Lansing: Michigan State University. (Eric Document Reproduction Service No. ED 001 273)

Scardamalia, M., & Bereiter, C. (1983). The development of evaluative, diagnostic, and remedial capabilities in children's composing. In M. Martlew (Ed.), *The psychology of written language: A developmental approach* (pp. 67–95). London: Wiley.

Scardamalia, M., & Bereiter, C. (1985). The development of dialectical processes in writing. In D. Olson, N. Terrance, & A. Hildyard (Eds.), *Literacy, language and learning: The nature and consequences of reading and writing*. Cambridge, England: Cambridge University Press.

Scardamalia, M., & Bereiter, C. (1986). Research on written composition. In C. Wittrock (Ed.), *Handbook of research on teaching* (3rd ed., pp. 778–803). New York: Macmillan.

Scardamalia, M., Bereiter, C., Gartshore, S., & Cattani, C. (1980, April). *Locating the source of children's revision difficulties*. Paper presented at the annual meeting of the American Educational Research Association, Boston.

Scardamalia, M., Bereiter, C., & Goelman, H. (1982). The role of production factors in writing ability. In M. Nystrand (Ed.), *What writers know: The language, process, and structure of written discourse* (pp. 113–210). New York: Academic Press.

Shaw, R. A., Pettigrew, J., & van Nostrand, A. D. (1983). Tactical planning of writing instruction. *The Elementary School Journal, 84*, 45–51.

Smith, G. L. (1982). Revision and improvement: Making the connection. In R. A. Sudol (Ed.), *Revising: New essays for teachers of writing* (pp. 132–139). Urbana, IL: ERIC Clearinghouse on Reading and Communication Skills, National Institute of Education, and National Council of Teachers of English.

Sommers, N. (1980). Revision strategies of student writers and experienced adult writers. *College Composition and Communication, 31*, 378–388.

Sperling, M., & Freedman, S. W. (1987). *A good girl writes like a good girl: Written response and clues to the teaching/learning process*. (Tech. Rep. No. 3). Berkeley: University of California and Pittsburgh, PA: Carnegie Mellon University.

Squire, J., & Applebee, R. (1968). *High school English instruction today: The national study of high school English programs*. New York: Appleton-Century-Crofts.

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

Tierney, R. J., & Pearson, P. D. (1985). Toward a composing model of reading. In C. N. Hedley & A. N. Baratta (Eds.), *Contexts of reading* (pp. 63–77). Norwood, NJ: Ablex.

Tressler, J. C. (1912). The efficiency of student correction of composition. *English Journal, 1*, 405–411.

van Dijk, T. A. (1980). *Macrostructures: An interdisciplinary study of global structures in discourse, interaction, and cognition*. Hillsdale, NJ: Erlbaum.

van Gelder, R. (1946). *Writers and writing*. New York: Charles Scribner's Sons.

Vosniadou, S., & Brewer, W. F. (1987). Theories of knowledge of restructuring in development. *Review of Educational Research, 57*, 51–67.

Vukelich, C. (1986). The relationship between peer sharing and seven-year-olds' text revisions. In J. A. Niles & R. V. Lalik (Eds.), *Solving problems in literacy: Learners, teachers and researchers. Thirty-fifth Yearbook of the National Reading Conference* (pp. 300–305). Rochester, NY: National Reading Conference.

Wason, P. C. (1980). Specific thoughts on the writing process. In L. W. Gregg & E. R. Steinberg (Eds.), *Cognitive processes in writing* (pp. 129–137). Hillsdale, NJ: Erlbaum.

West, W. W. (1967). Written composition. *Review of Educational Research, 37*, 159–167.

Witte, S. P. (1985). Revising, composing theory, and research design. In S. Freedman (Ed.), *The acquisition of written language: Response and revision* (pp. 250–284). Norwood, NJ: Ablex.

Woodruff, E., Bereiter, C., & Scardamalia, M. (1981). On the road to computer assisted compositions. *Journal of Educational Technology Systems, 10*(2), 133–148.

Author

JILL FITZGERALD, Associate Professor, Reading and Language Arts, School of Education, 037A Peabody Hall, University of North Carolina, Chapel Hill, NC 27514. *Specializations*: reading comprehension, writing processes, learning through writing.