

## **Metacognition, Comprehension Monitoring, and the Adult Reader**

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*This article provides an overview and synthesis of the current literature on metacognition and comprehension monitoring among adult readers. It is organized around three major research questions: (1) How do adults conceptualize their own comprehension-fostering and comprehension-monitoring activities? (2) How effectively do adults evaluate and regulate their ongoing efforts to understand? (3) How successfully do adults assess the final products of their comprehension efforts? Cutting across these broad issues are questions concerning metacognitive differences as a function of reading ability, academic success, domain expertise, developmental level, and task variables. The research reveals that adults' conceptions of how they comprehend and how they monitor their comprehension are quite variable. In general, those who have more expertise, who are better readers, and who are more successful students seem to have greater awareness and control of their own cognitive activities while reading. The research also reveals that adults evaluate and regulate their ongoing efforts to understand, although there is considerable room for improvement in these skills. Finally, the research shows that adults are remarkably unsuccessful at assessing how well they have comprehended a text and whether or not they are ready to take a test on the material. The article closes with a discussion of recent intervention efforts aimed at enhancing the metacognitive skills of adult readers.*

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## INTRODUCTION

In their 1984 review of the literature on metacognitive skills of reading, Baker and Brown (1984a) commented, "It is unfortunate that there is not more research activity in the area of adult metacognition. Anyone who has ever taught a group of college students must know that their metacognitive skills in a variety of domains could stand considerable enhancing!" (p. 380). Empirical support for this anecdotal observation was provided that same year in a survey by Simpson (1984) of study strategies used by college freshmen. Among Simpson's conclusions were the following: students use a restricted range of study strategies; they can rarely explain why a strategy is important to their own learning efforts; they use the same single strategy for most learning tasks; and they have little conception of how to check when they are ready for a test. Simpson offered three explanations for her disconcerting findings, all of which are undoubtedly contributing factors. (1) Students overrely on partially adequate strategies, such as underlining and rereading, which served them well in the past; (2) students do not generalize strategies they have been taught in one context to new situations; and (3) students do not engage in the cognitive monitoring activities of planning, checking, evaluating, and regulating, which are necessary for self-regulation of their own learning.

Researchers have apparently taken these concerns to heart, and we are now seeing increased attention to metacognition and comprehension monitoring in older readers. The purpose of the present article is to review this literature, with particular attention to research published within the past five years. We will begin by examining adults' metacognitive awareness about their reading strategies and their reported use of comprehension-monitoring activities. We will then turn to the comprehension-monitoring skills actually exhibited by adult readers, examining their ability to evaluate and regulate their ongoing comprehension. The next section of the article will focus on the self-assessment of comprehension and test readiness, a line of research that evolved somewhat independently of the literature on metacognition. Throughout these sections we will consider the relation of reading ability and academic performance to metacognition. A separate section will focus specifically on the issue of developmental differences. Finally, the article will examine some of the interventions designed to improve the metacognitive skills of adult readers.

A few comments about the scope of the review are in order. One frequently finds in the literature on metacognition a blurring of the distinction between strategies for comprehending and strategies for remembering. This is understandable given that effective studying has as a prerequisite effective comprehension. However, it is not the purpose of this review to examine the vast literature on study strategies; therefore, discussion of study strategies will be restricted to those that could legitimately be considered compre-

hension strategies as well (i.e., remembering-through-understanding strategies; Levin, 1986). [See the recent volume edited by Weinstein *et al.* (1988) for discussion of metacognition in the context of learning and study strategies.]

It is also important to bear in mind that there is much variability in the literature as to how metacognition is defined and as to what qualifies as a metacognitive strategy. Sometimes the behaviors in question are unambiguously strategic and clearly reflect cognitive monitoring, as in generating questions to test one's understanding. However, sometimes the behaviors are of questionable strategic status, such as underlining, and probably are best referred to as techniques rather than strategies.

Most of the research to be discussed in this review is based on the behaviors of college students. Although a few relevant studies have used as subjects underprepared college students, high school students, and adults who are not college students, assume unless otherwise stated that the subjects were college students enrolled in introductory psychology courses.

### **ADULTS' REPORTS OF THEIR METACOGNITIVE ACTIVITIES WHILE READING**

One of the most frequently used methods for learning how mature readers evaluate and regulate their comprehension and learning from text is to ask them directly. Such self-reports have been collected in a variety of ways. Readers may be asked to think aloud about what they were doing and thinking as they read or to provide written comments periodically throughout the reading session (e.g., Afflerbach, 1986; Bereiter and Bird, 1985; Block, 1986; Garner and Alexander, 1982; Lundeberg, 1987; Olson *et al.*, 1981). Readers may be asked to complete check lists of reading and study behaviors they use (e.g., Brennan *et al.*, 1986; Cioffi, 1986; Phifer and Glover, 1982; Spring, 1985) or they may be asked to report their strategies retrospectively or introspectively (e.g., Fischer and Mandl, 1984; Garner, 1982; Kaufman *et al.*, 1985; Lundeberg, 1987; Ryan, 1984; Smith, 1985).

Researchers today are sensitive to the need for caution in using verbal report measures (see, e.g., Afflerbach and Johnston, 1984; Ericsson and Simon, 1980; Garner, 1982); accordingly, they make an effort to collect converging evidence. Unfortunately, the evidence does not always converge, as is apparent in investigations of the relation between self-reports and observed strategy use. For example, Brennan *et al.* (1986) asked students to study a reading assignment and to report the techniques they used as they studied. An observer kept records of the students' overt behaviors and self-reports. After reading, the students completed a checklist indicating on a five-point scale how often they used specified strategies. Students gave high frequency ratings to most of the strategies, but the strategies in fact were rarely observed during reading. It is not always the case that students overstate their

strategy use, however. In fact, the opposite pattern was found by Phifer and Glover (1982): many students who underlined while reading failed to report doing so. Nevertheless, there is frequently a good deal of correspondence between self-reports and actual behaviors (e.g., Alexander, 1986; Garner, 1982), giving us reason to continue including verbal reports in our metacognitive research arsenal.

In the sections that follow we will first characterize the metacognitive strategies reported by “expert” readers. We then consider research comparing the behaviors of better and poorer readers, followed by consideration of whether metacognitive strategies are associated with superior performances. The final section examines individual differences in patterns of reported metacognitive strategies.

### Characterizing the “Expert” Reader

We begin by examining the strategies proficient readers report using to promote and monitor their comprehension. In research addressing this issue, graduate students and professionals typically serve as the “expert” readers (e.g., Afflerbach, 1986; Bereiter and Bird, 1985; Lundeberg, 1987; Smith, 1982, 1985). To illustrate, Smith (1982, 1985) collected introspective reports from graduate students as they read texts that were very difficult for them. She asked them to describe how they achieved comprehension, what criteria they used to judge comprehension, and how they decided comprehension had been achieved. Bereiter and Bird (1985) collected think-aloud protocols from graduate students and adults employed in middle-class occupations. The subjects were asked to read aloud a set of passages representing a variety of genres and to express all thoughts as they came to mind.

Smith’s expert readers reported a variety of effective strategies, including setting goals, inspecting text to activate appropriate prior knowledge and establish a framework for new information, integrating new information into existing knowledge structures, and monitoring learning. Many of the strategies they reported served the dual purpose of fostering comprehension as well as monitoring it, such as discriminating important from unimportant information and formulating questions. Bereiter and Bird restricted their protocol analyses to strategies the readers used for dealing with comprehension difficulties (i.e., for regulating comprehension). Four such strategies were identified: restatement, where the reader tries to rephrase the material into simpler terms; backtracking, where the reader looks back at previous text; demanding relationships, where the reader identifies information that ought to be provided or clarified in subsequent text and sets up “watchers” for the information; and problem formulation, where the reader identifies a particular difficulty as a problem that must be resolved. In sum, these studies pro-

vide support for the idealized profile of the proficient reader described by Baker and Brown (1984a, 1984b).

Research on the strategies used by proficient readers has also highlighted the important role of domain expertise. For example, Lundeberg (1987) examined metacognitive strategies within the specialized domain of legal-case analysis. She collected verbal reports from law professors and practicing lawyers using a modified think-aloud procedure as they read through a legal case. Their responses were compared to those of proficient readers with at least a master's degree but no experience in law. There were six general strategies characteristic of the legal experts; these included using context, over-viewing, rereading analytically, underlining, synthesizing, and evaluating. These strategies were used much less frequently by the legal novices. Moreover, novices engaged in behaviors not used by the experts, including expressing confusion about legal terms and familiar words with legal meanings. Interestingly, this focus on word understanding is typical of young novice readers as well (e.g., Baker, 1984). Novices often attributed the difficulties they were having to themselves rather than to the text; again, just as many young readers do. Experts and novices also allocated time differently, with experts using knowledge of text type to focus on the important information and modify their reading rate accordingly.

Domain expertise affects metacognitive strategies not only through knowledge of text type but also through knowledge of content. This was shown by Afflerbach (1986), who compared the verbal reports of experts and novices within specific disciplines. Doctoral students in chemistry and cultural anthropology read a passage from their own discipline and one from the other. They read each passage aloud and gave ongoing verbal reports of the processes they used to construct statements of the main ideas. The readers used a variety of cues to assign importance, including contextual knowledge-based cues, text structure cues, and cues provided by the author. Of particular interest is that the specific cues selected varied with domain familiarity and the goals readers set for themselves.

### **Differences Between Better and Poorer Readers**

It has been well established that children differ considerably in their metacognitive knowledge as a function of their reading ability (e.g., Baker and Brown, 1984a, b; Garner 1987). Do such differences exist among mature readers as well? The research offers a fairly consistent affirmative answer to this question, as we shall see. Moreover, differences have been found not only when the disparity between better and poorer readers is great, as in Gambrell and Heathington's (1981) comparison of adult disabled readers and proficient college readers, but also when comparisons are between high

and low scorers on standardized reading-comprehension tests, who are otherwise matched in intellectual ability (e.g., Meeks *et al.*, 1984). It should be noted, however, that a few studies have failed to find consistent relations between reported strategy use and reading performance (e.g., Pace *et al.*, 1985; Phifer and Glover, 1982).

A particularly intriguing outcome of this comparative research is that ability-related differences frequently appear in the use of strategies for understanding, but not in the use of strategies for remembering. To illustrate, Kaufman (1985) collected retrospective reports from students about the strategies they engaged in while reading short passages and answering comprehension questions about the material. High and low comprehenders, as defined by their scores on the Nelson-Denny, did not differ in their use of "observable" strategies, but they did differ in those that occur "inside the head," to use Kaufman *et al.*'s terminology. For example, high comprehenders reported using more strategies when they encountered a comprehension difficulty than did low comprehenders, but high comprehenders were no more likely to underline than were low comprehenders.

Spring (1985) also demonstrated that poor readers differ from good readers in their use of comprehension strategies but not in their use of study strategies. College freshmen enrolled in a remedial reading course and freshmen who were considered good readers were provided with a list of text-learning strategies and were asked to indicate whether they used each strategy frequently, sometimes, or never. The strategies were shown through factor analysis to cluster into two discrete factors associated with comprehension, and three factors associated with studying. Good readers more frequently used all three strategies included in the factor called "understanding": relating information to prior knowledge, identifying logical relationships within text material, and mentally identifying important ideas. They also more frequently used one strategy included in the factor of "critical reading": reacting emotionally and critically to text material. Good readers did not differ from poor readers in their use of any of the strategies associated with studying, with the exception that they less frequently outlined text material. Somewhat surprisingly, they also did not differ in their use of remembering-through-understanding strategies (Levin, 1986), such as summarizing or paraphrasing. Spring suggested that poor readers may rely heavily on low-level study strategies in an attempt to compensate for their insufficient comprehension. This finding highlights a serious shortcoming of much college-level remedial reading instruction: its exclusive focus on study strategies, with little attention to comprehension, "... may fail to apply the correction where it is most needed" (Spring, 1985, p. 166).

There is also some evidence that good and poor readers differ more in how they cope with comprehension difficulties than in how they promote or evaluate comprehension. Kletzien (1988) compared the comprehension

strategies reported by achieving and nonachieving high school readers as they completed cloze tasks on expository passages. When the passages were at easy or intermediate levels of difficulty, better and poorer readers alike tended to rely on the same small set of strategies (rereading previous text, using prior knowledge, making inferences, and using key vocabulary). However, on difficult passages, the nonachieving readers essentially gave up, using few if any strategies, while the achieving readers persisted in their efforts to understand.

Fischer and Mandl (1984) reported similar differences between good and poor readers in their responses to comprehension failures. Biology students were asked to read a psychology passage in preparation for free recall and multiple-choice tests. After taking the tests, the students were interviewed about how they had prepared for them. Good and poor readers did not differ in whether or not they monitored their comprehension and learning, but they did differ in how they responded to difficulties. The poor readers exhibited negative affect about themselves as learners. Accordingly, although they monitored their ongoing progress, they responded to difficulties they encountered as affirmations of their failure expectations and made no effort to cope with them. The good readers, in contrast, used the information they acquired through self-assessment in a functional way, to regulate future progress.

### **Do Metacognitive Strategies Predict Future Performance?**

We have just seen that individuals with greater awareness of how best to promote, evaluate, and regulate their own comprehension and learning tend to be better readers. Do such individuals also tend to be better test-takers? The research on this question again suggests an affirmative answer, although there exists some evidence to the contrary (e.g., Pace *et al.*, 1985). Block (1986) found that students who reported monitoring their comprehension and dealing with comprehension failures had better passage recall and earned higher grade-point averages (GPAs) than students who did not. Evidence provided by Fischer and Mandl (1984) suggests that effective regulation of comprehension may be a more important determinant of performance than evaluation of comprehension. Students who dealt adequately with their comprehension failures performed better on tests of free recall than students who did not, but even the less successful students evaluated the state and quality of their ongoing comprehension.

Superior test performance has even been linked to the use of one very specific strategy. Garner and Alexander (1982) asked students to read a lengthy passage in preparation for answering a question about it. At four points throughout the passage, students were asked to stop and reflect on how they were reading and preparing to answer the question. Of particular

interest was whether students would verbalize the strategy of trying to figure out what the question would be, a highly adaptive strategy given the task demands. Half of the students did so, and these students provided superior answers on the test question. It was not the case that these students engaged in more strategies of all types; rather, it appears that it was the specific strategy that accounted for better performance.

Research also suggests that the range of strategies available to a student appears to be a good predictor of test performance. Nist *et al.* (1985) asked students in an upper-level developmental reading course to describe how they prepared for tests over content area text chapters. The greater the number of positive strategies students reported, the better their test performance, even when verbal ability effects were partialled out. Ryan (1984), in a study to be described in more detail subsequently, also found that students who reported using a greater number of different criteria for evaluating their comprehension earned higher course grades. Moreover, the nature of the reported evaluation criteria was also related to performance, with students who used higher-level criteria earning higher grades than those using lower-level criteria.

Thus far, we have considered how metacognition relates to performance in academic contexts. An important extension of this line of research is to ask how metacognition relates to performance in the workplace. Mikulecky and his colleagues examined the influence of metacognitive aspects of literacy on the job performance of nurses (Mikulecky and Winchester, 1983) and electronics technicians (Mikulecky and Ehlinger, 1985). They found that metacognitive awareness and reported use of metacognitive strategies, such as self-questioning, focusing on key ideas, and setting purposes, were more common among workers considered superior at their jobs than among workers considered adequate performers. Moreover, the basic literacy abilities of the workers did not differ among performance groups, leading Mikulecky and Ehlinger (1985) to suggest that job performance may be "more closely related to metacognitive aspects of literacy than to the basic literacy abilities of achieving simple comprehension or communicating simple messages" (p. 45). This is an intriguing suggestion; further research aimed at replicating the results among workers in other occupations is clearly warranted.

### **Individual Differences in Patterns of Strategy Use**

Evidence has already been offered suggesting differences in patterns of strategy use between better and poorer readers, between more successful and less successful students, and between domain-area experts and novices. In this section we consider more directly the question of whether there are consistent patterns of strategy use that differ among individuals.



Cioffi (1986) provided an affirmative answer to this question in a study of college freshmen identified as successful readers. Subjects were given a list of 19 comprehension and study strategies and were asked to indicate on a six-point scale the frequency of use of each strategy. Cluster analyses revealed six clusters of strategies that tended to be used in conjunction with one another. One cluster consisted of text-driven strategies; a second cluster consisted of reader-driven strategies; and four clusters consisted of interactive strategies. All of the interactive clusters included strategies for monitoring understanding. Thus, for example, readers fitting one of the interactive profiles used context to figure out unknown words and generate questions for self-testing. Readers fitting another interactive profile pictured the concepts, paraphrased the text, and set goals for how well they needed to learn the material. An important question that remains unanswered is whether these strategy clusters are stable over time. However, Alexander (1986) provided corroborative evidence that students differ in terms of whether their strategy profiles are text-driven, reader-driven, or interactive.

Individual differences in patterns of reported strategy use have been observed within groups of poor readers as well as good readers. Block (1986) collected think-aloud protocols from remedial reading students as they read two passages from a low-level introductory psychology text. They were instructed to read silently and to stop at specified points to report what they were thinking as they read and what they did when they did not understand. Two general strategy patterns were identified. "Integrators" were those who integrated text information, commented on text structure, monitored their comprehension, and tried to deal with comprehension failures. Note that this pattern of strategy use resembles that of our prototypical expert reader. "Nonintegrators" focused on details rather than main points and responded to the text on an affective level, focusing on their own thoughts and feelings rather than the author's message. Students who were integrators were able to recall the passages more successfully than the nonintegrators. Moreover, the integrators showed improvement in their standardized reading scores over the semester and achieved a higher overall GPA.

Particularly intriguing evidence of individual differences was provided by Ryan (1984), who explored how students' beliefs about the nature of knowledge relate to the standards they use to evaluate their comprehension. Ryan proposed, as has Baker (e.g., 1984, 1985a, b), that a major source of individual differences in reading ability may be the criteria one applies for evaluating comprehension. He adopted Perry's (1970) notion that people differ in their epistemological standards; some people have a dualistic orientation (i.e., right or wrong, true or false) and others have a relativistic orientation. He suggested that the dualist, who conceives of knowledge as a set of discrete truths, ought to assess reading comprehension in terms of the number of propositions that can be retrieved from memory after reading. The relativist, in contrast, conceives of knowledge as the framework within which

particular facts are interpreted, and so he or she ought to assess reading comprehension in terms of the degree to which clear and coherent relationships can be established among propositions. Accordingly, Ryan predicted that dualists would use more standards concerned with knowledge acquisition, whereas relativists would use more standards concerned with comprehension and application.

Students were identified as dualists or relativists depending on whether or not they agreed with statements reflecting a dualism orientation; such as, "If professors would stick more to the facts and do less theorizing one could get more out of college." Students were given 15 minutes to respond to a comprehension-monitoring probe asking how they determine whether they have understood material well enough, what information they use to assess their degree of understanding, and how they decide whether they need to reread or seek help. Fifteen different monitoring criteria were identified and categorized as to whether they reflected a knowledge standard or a comprehension/application standard. The most commonly reported knowledge criteria were recalling information from the text in response to study guide questions and recalling information from the text as part of mental review. The most commonly reported comprehension/application criteria were determining the meaning of individual sentences and paraphrasing the text. It is perhaps telling that application of these particular standards does not require extensive integration of the text. Consistent with expectations, the choice of standard was associated with one's beliefs about the nature of knowledge: knowledge standards were more likely to be used by dualists than relativists. The study also revealed that students who used several different criteria, and those who used at least one standard for comprehension/application, were more likely to earn *As* or *Bs* in their introductory psychology course than students who used few criteria and those who used knowledge standards exclusively.

## COMPREHENSION MONITORING

In this part of the article we will consider the extent to which adult readers monitor their comprehension. We previously saw that adult readers frequently report that they engage in comprehension-monitoring activities. But how effective is their monitoring? This question has been asked most frequently by using the "error detection" paradigm: readers are presented with texts that contain embedded problems or errors and they are asked to report them. The assumption underlying this paradigm is that these problems disrupt comprehension, and so the reader who is checking his or her ongoing comprehension should notice them. Much of the research has shown that

adults are not very successful at identifying the embedded problems; detection rates tend to average about 50% across studies (e.g., Baker, 1979, 1985; Baker and Anderson, 1982; Epstein *et al.*, 1984; Glenberg *et al.*, 1982; Grabe *et al.*, 1987). However, caution is necessary in interpreting results of studies using this paradigm, as Baker (1979) illustrated in a study that first explicitly addressed the question of how well college students monitor their comprehension.

In that study, students were instructed to read carefully six expository passages containing different types of embedded problems (internal inconsistencies, inappropriate logical connectives, and ambiguous referents) in preparation for answering subsequent discussion questions. After reading and answering questions calling for recall of the deficient sections of text, subjects were informed that the passages contained problems and were asked to report them, rereading as necessary. The students were also questioned as to whether or not they noticed the problems during reading, how they had interpreted them, and how they affected their overall understanding. Most surprising was that only 38% of the problems were detected, and fewer than 25% of these were reported noticed during reading. Nevertheless, the recall protocols and retrospective reports made it clear that many failures to report problems were not due to failures to evaluate comprehension, but rather to the use of fix-up strategies for resolving comprehension difficulties. In other words, subjects attempted to evaluate *and* regulate their comprehension. Many students reported strategies similar to those described by Bereiter and Bird (1985), such as backtracking and seeking clarification in subsequent text.

Thus, the study illustrated that mature readers go to great lengths to make sense of text, especially if they have no reason to suspect that the texts were rigged to be difficult to understand. Researchers are now sensitive to this issue, and so the amount of information subjects are provided about the nature of the materials is carefully taken into account. Several studies to be considered below compared groups of readers who are informed versus uninformed about the presence of problems (e.g., Baker, 1985a, 1986; Baker and Anderson, 1982; Grabe *et al.*, 1987), whereas others have explicitly informed all subjects that specific types of problems would be present (e.g., Epstein *et al.*, 1984; Glenberg *et al.*, 1982; Zabrocky *et al.*, 1987).

The Baker (1979) study also revealed that adult readers use a variety of different criteria for evaluating their understanding; in fact, the subjects frequently reported problems other than those the experimenter intended to convey. This led Baker (1984, 1985b) to caution that failure to notice a particular type of problem embedded in a text does not necessarily imply poor comprehension monitoring. For example, the reader who fails to notice a contradiction within a passage presumably was not evaluating his or her un-

derstanding with respect to an internal consistency standard; however, he or she may have been using alternative criteria for evaluating comprehension. In the next section we will consider research on adults' use of multiple standards for evaluating their comprehension. We will then consider research that uses process measures of comprehension monitoring rather than relying exclusively on verbal reports. We then turn to a consideration of some of the factors affecting identification of embedded problems, followed by a brief discussion of the limited research on the regulation component of comprehension monitoring.

### Standards for Evaluating Comprehension

After reviewing the literature on comprehension and comprehension monitoring, Baker (1985b) identified seven different standards of evaluation that are used by adult readers. The *lexical* standard involves checking that the meaning of an individual word is understood. The *syntactic* standard involves checking grammaticality and syntactic appropriateness. The *external consistency* standard involves checking that the ideas in the text are true or plausible with respect to what one already knows. The *propositional cohesiveness* standard involves checking that a cohesive relationship can be established among propositions sharing a local context. The *internal consistency* standard involves checking that the ideas expressed in the text are logically consistent with one another. The *structural cohesiveness* standard involves checking that the ideas in a text or paragraph are thematically compatible. The *informational completeness* standard involves checking that the text contains all of the information necessary to achieve a specific goal. Successful application of the different standards requires different levels of analysis of the text. For example, the lexical standard can be applied without even taking the meaning of surrounding context into account, whereas the internal consistency standard requires integration of propositions, perhaps from widely separated sections of the text.

Much of the research on comprehension monitoring has focused exclusively on readers' use of the internal consistency standard by embedding contradictory information within the text. However, Baker (1985a; 1986) has examined college students' use of multiple standards of evaluation. In the 1985 study, passages were adapted from college-level textbooks and modified to contain problems that could be noticed by application of the lexical standard (nonsense words), the external consistency standard (prior knowledge violations), and the internal consistency standard (contradictions). Students with verbal SAT scores that were either high ( $M = 580$ ) or low ( $M = 380$ ) participated in the study. Half of the subjects were explicitly informed

of the nature of the embedded problems and were given examples of each type. The remaining subjects were alerted to the fact that the passages contained problems, but they were given no further information. The subjects read each passage at their own pace, underlining anything problematic and explaining the nature of the problem to the experimenter.

Problem identification differed as a function of problem type, verbal ability level, and instructions. Nonsense words were most likely to be identified, prior knowledge violations much less so, and contradictions even less so. This ordering is consistent with the hypothesized difficulty of applying the different standards. The higher-ability students who received specific instructions identified more problems than any of the other groups. Whether or not a standard would be adopted at all also depended on instructional condition and verbal-ability level. Although the lexical standard was applied equally often by subjects in both instructional conditions, the external consistency and internal consistency standards were less likely to be adopted by subjects receiving general instructions. In addition, there were more students in the low verbal-ability group who never used the internal consistency standard.

Also of interest was that higher verbal students used more different standards (including nontarget standards) than the lower verbal students. This indicates that not only do the less effective readers report fewer obstacles to comprehension, but they also have a more limited set of criteria against which to evaluate their understanding. Moreover, of those lower-ability students who used but one or two different standards, the lexical standard was one of those included in their repertoire. Many younger, poorer readers over-rely on the lexical standard (e.g., Baker, 1984); apparently, even less-proficient mature readers do so as well. These results nicely supplement the self-report data of Ryan (1984), discussed earlier. Recall that Ryan found that better students reported using more different criteria for evaluating their understanding, and they reported using higher-level standards of evaluation than poorer students.

In a more direct examination of the use of all seven standards of evaluation, Baker (1986) adapted two lengthy passages from grade school expository texts and embedded within them problems calling for the use of each standard. As in the previous study, the effects of verbal ability and specificity of instructions were examined. Even with considerably easier materials, problem identification was at far from ceiling levels, with detection rates ranging from 0.79 for syntactic problems to 0.54 for propositional cohesiveness problems. Results again showed better problem identification among subjects receiving specific rather than general instructions. The syntactic and informational completeness standards were used effectively by all subjects, whereas the remaining standards were used more effectively by the students

with better verbal skills. Analysis of the number of different standards used revealed that many of the adults used all seven on at least one occasion; all but 3% used five or more. This indicates that the relatively poor problem identification cannot be attributed to use of a restricted range of standards. Rather, it seems that subjects did not apply the standards that were available in their repertoire as consistently or as effectively as they could have.

### **Process Measures of Comprehension Monitoring**

Although requesting subjects to underline problematic segments of text as they encounter them provides some evidence of "on-line" comprehension monitoring, this methodology is only possible when subjects are informed in advance of the existence of problems. Researchers are particularly interested in the extent to which readers monitor their understanding spontaneously, but we have already seen that exclusive reliance on postreading verbal reports is insufficient. Therefore, a valuable adjunct to verbal report measures is to collect process measures of reading behavior, such as reading times and eye-movement patterns. We will now consider the few studies that have done so.

Baker and Anderson (1982) constructed expository passages containing internal inconsistencies and presented them to college students sentence by sentence on a computer terminal. Subjects advanced to subsequent sentences at their own pace, and they were free to reexpose previously read sentences at will. Half of the students were informed prior to reading that inconsistencies were present; half were not so informed until later. After reading, the students were asked to indicate which sentences, if any, contained inconsistencies. As expected, students spent more time reading inconsistent target sentences than consistent target sentences, and they looked back at previous sentences more frequently when inconsistencies were present. These modifications in processing suggest that subjects monitored their comprehension as they were reading, evaluating whether the ideas expressed in the text were consistent with one another. Of particular significance was the fact that students who were explicitly instructed to monitor for inconsistencies during reading did not differ from uninformed readers. Despite these trends, subjects identified only 64% of the inconsistencies when explicitly asked to do so. Moreover, only two thirds of the subjects reported noticing the inconsistencies during reading. Those who said they noticed them during reading did in fact spend more time reading the inconsistent sentences, suggesting the self-reports were valid.

Analyses of eye-movement patterns have also shown that informed and uninformed subjects are equally sensitive to internal inconsistencies. Grabe *et al.* (1987) presented students with short expository paragraphs, half of

which contained intersentence contradictions and half of which were intact. Subjects in the informed condition were instructed to find and report contradictions. As in other studies, their detection rate was low, only 47%. Subjects in the uninformed condition were told that the paragraphs differed in level of difficulty and that they were to try their best to understand the meaning. Analyses of eye-movement patterns revealed that subjects in both instructional conditions modified their reading behaviors during the first pass through the paragraphs in response to the contradictory sentences. However, the two groups did differ on the second pass through the paragraphs, with informed subjects rereading the paragraphs more often. The authors suggest this difference reflects preparation on the part of the informed readers to report the errors they had found. Similar results were obtained in a replication study by Grabe *et al.* (1988).

Green *et al.* (1981) demonstrated through analysis of reading times that adults are also sensitive to problems of structural cohesiveness. College students were presented with a passage a few words at a time. They read the segments at their own pace and initiated presentation of the subsequent segments. In one version of the passage, a thematically anomalous phrase was embedded within a single segment, but not until a subsequent segment of the sentence was reached did it become apparent that the phrase was anomalous. Reading times were greater on this latter segment for subjects who received the anomalous version than for those who read the standard version. In addition, eight subjects were given explicit instructions to press a special button as soon as they identified "something odd in context and fairly gross." Seven of the subjects pressed the button on first encountering the latter segment, and the eighth pressed the button on the next segment, reportedly having tried and failed to resolve the problem.

On-line sensitivity to violations of external consistency has been demonstrated in a study by Tikhomirov and Klochko (1981); the process measure in this study consisted of galvanic skin responses (GSRs). A narrative passage containing propositions violating basic laws of physics (e.g., rivers that flow *up* mountains) was presented to high school students, undergraduate physics majors, and faculty and graduate students in the physics department. The subjects were first asked to check the passage's grammaticality and after doing so, to recall the passage. They were then asked to read the passage aloud in preparation for a second retelling. After recall, they were asked whether they had noticed any problems. If they had not, they were given the specific task of searching for the problems, using a think-aloud procedure. Throughout the session, GSRs were recorded. Only one of the 45 subjects reported any problems while checking for grammaticality. This is not surprising given that the subjects were set to carry out relatively superficial processing of the text. More surprising, especially because many of these subjects qualified as domain experts, was that only two people reported the problems after the

second task, which presumably required deeper processing. However, with specific instructions to find the problems, the detection rate rose to 84%. The GSR data provide important information to supplement these verbal reports. They suggest that some of the subjects who did not report the problems initially may have detected them at some subconscious level. The GSR recordings of these subjects fluctuated sharply when they read the contradictory information. Moreover, all of the skin-responsive subjects went on to report the problems when instructed to seek them. In contrast, none of the subjects whose GSR recordings were stable reported the problems subsequently.

### **Factors Influencing Problem Identification**

Many of the studies of comprehension monitoring have manipulated variables assumed to affect the likelihood that subjects would notice the intentionally embedded problems. We have already considered research examining one of these variables, the amount of information subjects are given about the problematic nature of the materials. Although subjects appear to modify their processing of text in response to embedded problems regardless of whether they know problems are present (Baker and Anderson, 1982; Grabe *et al.*, 1987; 1988), they are more likely to identify problems when they know exactly what kind of problems to expect (Baker, 1985a, 1986). This finding can best be interpreted in terms of Grice's (1975) cooperative principles; that is, people ordinarily believe that the messages they receive will be true, complete, and informative, and consequently they attempt to make sense of any input, however confusing. This effort after meaning leads to increased processing time when a problem is encountered, but whether or not the problem will actually be reported depends on several factors: the subjects' goal for reading, the criteria they adopt for evaluating their understanding, and their threshold for deciding when a problem is serious enough to report. We have also seen that the nature of the problems themselves is an important variable, with subjects more likely to identify problems requiring the use of a word-level standard (i.e., the lexical standard) than those requiring more extensive text integration processes (e.g., the internal consistency standard).

Recognizing that construction of a coherent text representation is central to effective comprehension, several researchers have hypothesized that those problems that are most disruptive to the meaning construction process should be most detectable. Accordingly, one variable that has been studied is whether the problem involves the main point of a passage or a detail. Results of these studies have been mixed, and the reason for the discrepancy is un-



clear. Baker (1979) found that subjects were more likely to report problems when they involved main ideas of the passages rather than details, as did Yussen *et al.* (1986). However, Baker and Anderson (1982) found no differences in processing measures or in detection rates for main idea and detail contradictions, nor did Grabe *et al.* (1988).

Another variable hypothesized to affect the readers' efforts to come up with a coherent text representation is whether the information is marked syntactically as given or new. Glenberg *et al.* (1982) reasoned that if contradictory information is conveyed as new, there should be no reason for readers to attempt to link the contradiction with previous text, and so they should be less likely to detect it than if the information was conveyed as given. Participants in the study read three passages with inconsistent information conveyed as given, with inconsistent information conveyed as new, and with consistent information. Subjects were instructed to search for and identify the contradictions and to rate how well they understood the text. Detection rates were low, about 50%. However, as predicted, subjects were more likely to give high comprehension ratings yet fail to report the contradictions in versions marked as new rather than given. Similar results were obtained by Zabrocky *et al.* (1987) in a subsequent study using the same passages.

It should not be assumed, however, that information conveyed as given will necessarily be subjected to more careful evaluation than information conveyed as new. Whether or not this occurs appears to depend on the type of evaluation required. Baker and Wagner (1987) obtained the opposite pattern when information violated standards of external consistency rather than internal consistency. Subjects were presented with short paragraphs containing "facts" that violated common knowledge and were instructed to read the passages carefully in search of these facts. In some passages, the false information was conveyed as given by embedding it in a subordinate clause, as in the following: "The liver, which is an organ found only in humans, is often damaged by heavy drinking." In other passages, the information was conveyed as new by placing it in the main clause, as in: "The liver, which is often damaged by heavy drinking, is an organ found only in humans." The false facts were less likely to be identified when they were marked as given rather than new, indicating that readers do not evaluate the truthfulness of given information as carefully. Similar effects of markedness have been obtained by Bredart and Modolo (1988).

Necessary preconditions for problem identification have also been examined. For example, to notice an internal inconsistency, it is necessary that both constituents be concurrently active in working memory. Any factor that reduces the likelihood of coactivation reduces the likelihood of inconsistency detection. Epstein *et al.* (1984) identified three such factors: proximity of the constituents, identity of wordings of the constituents, and explicitness

of the contradiction. Subjects in their study, high school chemistry students, read passages adapted from science texts with explicit instructions to search for contradictions. Ratings of comprehension were provided after reading. Subjects were more likely to miss the contradictions when they were implicit rather than explicit, when the wordings of the constituents were paraphrased rather than identical, and when the contradictory constituents appeared between paragraphs rather than within. Detection rates were low even in the coactivation conditions, however, suggesting that although coactivation may be necessary, it is not sufficient.

### Regulation of Comprehension

Recognition that one has experienced difficulty in comprehending text is only the first step in comprehension monitoring; one must also decide what to do about it. Thus, readers must have available to them a variety of "fix-up" strategies for regulating comprehension. One useful way of distinguishing among fix-up strategies is in terms of their disruptiveness to the reading process (Collins and Smith, 1984). Deciding to ignore the problem may be regarded as the least disruptive approach, whereas consulting an outside source, such as a reference book or knowledgeable other, may be regarded as the most disruptive. Intermediate levels of disruptiveness include rereading previous text and looking ahead in search of clarification by setting up "pending questions" (Anderson, 1980) or "watchers" (Bereiter and Bird, 1985). There has been relatively little "on-line" research on regulation of comprehension; most of our information about the behavior of mature readers is based on verbal reports (e.g., Baker, 1979; Bereiter and Bird, 1985). However, empirical evidence of adults' use of two regulation strategies, rereading and consulting an outside source, will now be presented.

That readers spontaneously use a rereading or "lookback" strategy in response to a comprehension problem was demonstrated by Baker and Anderson (1982); upon encountering a sentence that conflicts with previous information, readers frequently reexpose the contradictory premise immediately afterward. However, they seldom use a lookback strategy spontaneously to help them find information necessary for answering text-based questions, as Alexander *et al.* (1984) have shown. Nevertheless, inducing readers to use a lookback strategy apparently has beneficial effects. Alessi *et al.* (1979) reported improved test performance among students who were induced to reread sections of text containing information about which they had answered questions incorrectly.

Induced "lookups" have also proven effective. Blohm (1987) gave proficient college readers the opportunity to search outside the text for information to help resolve comprehension difficulties. Subjects read highly technical

articles presented section by section on a computer in preparation for a free recall test. Half of the subjects were given the option of using a lookup for any sentence that they found difficult to understand. By pressing a key, the subjects were branched to a rewritten version of the sentence that had been made more comprehensible by using examples, analogies, and so on. Those subjects who were given the lookup option subsequently recalled more information than those without the option. Importantly, there was no direct relation between the number of idea units recalled and the number of lookups a subject took, suggesting that subjects were indeed monitoring their understanding; they looked up information only when they knew they were having trouble understanding it.

### ASSESSING ONE'S OWN LEVEL OF COMPREHENSION

In the previous section, we considered the effectiveness with which readers keep track of their *ongoing* comprehension processes. In this section we consider the effectiveness with which they evaluate the final product of their comprehension efforts. Research on the self-assessment of comprehension evolved along somewhat different lines than the research on metacognition and comprehension monitoring we have considered thus far. It had its origins in research on students' abilities to assess how well they had performed on a test (e.g., Shaughnessy, 1979). With this paradigm, students are given a test over some text material and they are asked to rate their confidence in the correctness of their answers. Research has shown that subjects are reasonably accurate at making such assessments (e.g., Glenberg and Epstein, 1985, 1987; Glenberg *et al.*, 1987; Maki and Swett, 1987; Pressley *et al.*, 1987; Schommer and Surber, 1986; Shaughnessy, 1979; see also Waern and Askwall, 1981, for conflicting results). However, postdictions about past performance require much less cognitive-monitoring sophistication than predictions about future performance. To make accurate assessments of past performance, subjects must be able to evaluate the quality of their responses to specific test questions. They need not evaluate the quality of their comprehension of the text material on which the questions were based, nor do they need to evaluate their ability to retrieve information from memory. Not surprisingly, subjects are considerably better at making postdictions than they are at making predictions, as we shall see.

An extensive research program on the self-assessment of comprehension has been conducted by Glenberg and Epstein and their colleagues (Epstein *et al.*, 1984; Glenberg and Epstein, 1985, 1987; Glenberg *et al.*, 1982, 1987). In the earlier studies (Glenberg *et al.*, 1982; Epstein *et al.*, 1984) failure in the self-assessment of comprehension was called the "illusion of knowing," and it was said to occur when subjects indicated that material containing

a contradictory sentence had been comprehended. In the later studies (Glenberg and Epstein, 1985, 1987; Glenberg *et al.*, 1987), subjects who did not assess their level of comprehension adequately were said to be “poorly calibrated.” The calibration construct originated with the “feeling of knowing” literature (e.g., Koriat *et al.*, 1980) and was extended by Glenberg and Epstein to comprehension assessment. We have already considered the earlier “illusion of knowing” studies in the section on comprehension monitoring (Glenberg *et al.*, 1982; Epstein *et al.*, 1984). Recall that subjects frequently rated their comprehension as good even though they failed to identify embedded inconsistencies. In other words, the illusion of knowing was very common. Glenberg and Epstein (1985) speculated that one reason subjects may have been so poor at assessing their comprehension in these earlier studies is that they were asked to rate their comprehension of the text as a whole. Thus, even if subjects had difficulty with certain parts of the text, they may have felt their general level of comprehension was sufficiently high to warrant a high rating. To help circumvent the problem of variability in rating criteria and to increase the generalizability of their results to everyday reading, Glenberg and Epstein adopted a new methodology for the later studies that we will now consider in more detail.

In the Glenberg and Epstein (1985) study, subjects in three experiments rated their confidence in their ability to draw correct inferences about the central themes of intact expository paragraphs. In all three experiments, the correlations between confidence ratings and performance were not significantly different from 0, indicating that subjects were poorly calibrated. In Experiment 1, subjects provided confidence ratings either immediately after reading each passage or after a delay; the delay variable did not affect calibration. Experiment 2 ruled out the possibility that poor calibration was due to subjects having inappropriate expectations about the nature of the inference questions. Subjects who were familiarized with sample inference items were no better calibrated than subjects without prior familiarization. In Experiment 3, subjects also rated their confidence in the correctness of their answers, assessed their ability to answer a new inference question, and then answered it. Of interest was whether subjects would be able to use the knowledge gained from completing the first inference question to generate a more accurate assessment of their comprehension. Subjects indeed were capable of recalibrating their comprehension. As in the earlier experiments, the correlation between initial ratings and performance was near 0, but the correlation between subsequent ratings and performance was significantly greater. In addition, subjects demonstrated good calibration of performance (i.e., their postdictions were accurate).

Glenberg and Epstein (1987) went on to examine the role that domain expertise plays in calibration of comprehension. To this end, students with

backgrounds in physics and music were selected as participants, and text materials dealt with topics within those domains. Measures of initial calibration, performance calibration, and recalibration were collected, as in Experiment 3 of Glenberg and Epstein (1985). Again, calibration of comprehension was poor and, in contrast to the earlier results, recalibration was also poor. However, on both measures there was a nonintuitive effect of expertise, such that subjects were *more* poorly calibrated in their own domain. The authors account for this finding by suggesting that subjects classified themselves as relatively expert in one or the other domain, and their confidence ratings on texts relevant to that domain were based on their belief in their own expertise rather than assessments of their actual comprehension. When subjects did not classify themselves as experts in a domain, their ratings likely were more influenced by actual assessments of their comprehension; accordingly, calibration was somewhat higher.

The third study in the series on calibration of comprehension (Glenberg *et al.*, 1987) consisted of eight experiments addressing questions raised by the earlier research. Two experiments demonstrated that poor calibration cannot simply be attributed to the difficulty of predicting performance on inference tests. Subjects were as poorly calibrated with verbatim recognition tests and idea recognition tests as they were with inference tests. Three experiments provided further evidence that poor calibration occurs because subjects assess domain familiarity rather than knowledge gained from a particular test when making their judgments. Results revealed that judgments of familiarity were highly correlated with confidence assessments. Three additional experiments demonstrated that self-generated feedback provided by a pretest can be used to enhance calibration, but only if the knowledge tapped by the pretest is related to the knowledge needed on the posttest. Subjects read a series of texts, completed idea recognition pretests, made confidence judgments about performance on the posttest, and then took the posttest. Calibration was greatest when subjects received pretests with items identical to those on the posttest, at intermediate levels with related pretests, and nonexistent with unrelated pretests.

Several other investigators have also examined how effectively students assess their comprehension and/or test readiness. Much of this work is related to the calibration work of Glenberg and Epstein, although the research questions and methods were often developed independently. We consider first a study by Maki and Berry (1984) that examined the effects of test-taking experience, as did Glenberg and Epstein, but with methodology more similar to academic testing situations. Students read chapters from introductory psychology texts dealing with unfamiliar topics and rated their confidence in their ability to answer multiple-choice questions based on each section of the chapter. On separate days, subjects read half of one chapter and made

their predictions, took a test on the material, read the second half of the chapter and made predictions, and took a test on the material. Subjects were generally overconfident in their ability to answer the questions on both tests; experience with testing had little effect. In other words, the subjects were poorly calibrated and there was no evidence of recalibration. Nevertheless, subjects who performed above the median on the test made fairly accurate predictions as to which sections of text would lead to correct test answers and which would lead to incorrect test answers, whereas subjects scoring below the median did not. A second experiment demonstrated that all subjects were fairly accurate at predicting performance on a test given immediately after reading; however, poorer students were not as effective as better students at predicting performance on a test delayed 24 or 72 hours.

Pressley *et al.* (1987) also examined how well students assess their readiness to take a test, but their focus was on global assessments of test readiness rather than judgments about specific questions or text segments. Subjects in three experiments read lengthy sections from introductory psychology texts and took tests on the material. Perceived readiness for examination performance was assessed at three different times for different groups of subjects: before reading, after reading but before testing, and after testing. Subjects indicated how many items on a multiple-choice or fill-in test they would be able to answer correctly (or did answer correctly). In all three experiments, prediction accuracy was greatest for the after-testing group and lowest for the before-reading group. The fact that subjects were most accurate after testing is not surprising given that their judgments were actually postdictions about past performance. That subjects were least accurate before reading also is not surprising given that the only basis for their judgments was domain familiarity and/or past experience with similar tests. Subjects in the after-reading group had intermediate levels of accuracy that generally did not differ significantly from either of the other groups. This lack of awareness of test preparedness is consistent with Glenberg and Epstein's finding of poor calibration. Somewhat surprisingly, midterm exam grades and reading comprehension scores were unrelated to perceived test readiness. Perhaps it is only when ability measures are based directly on the criterion test, as in Maki and Berry (1984), that such relationships are apparent.

The third experiment in the Pressley *et al.* study included an effort to increase awareness of test preparedness during reading by presenting some of the subjects with adjunct questions. The effort was successful, with the subjects who received adjunct questions showing greater accuracy when assessments were made after reading than before reading. Moreover, the after-reading subjects were more accurate in an interspersed adjunct condition than a no-adjunct condition, demonstrating that adjunct questions can in fact facilitate monitoring of test readiness.

We have now seen that poor self-assessment of comprehension is a widespread phenomenon among college students. Maki and Swett (1987) proposed two explanations for the problem: expository texts are often difficult to understand, and students do not know the exact nature and content of the test. To evaluate these explanations, Maki and Swett used easy-to-comprehend narrative texts and a test of free recall. After reading the narrative, students were presented with each idea unit from the text and predicted their ability to recall it. Then they recalled the text and gave confidence judgments about their accuracy. Subjects were significantly better than chance at predicting their performance on both an immediate test and a delayed test, and their postdictions about recall were also accurate. Maki and Swett argue that conclusions about subjects' ability to predict their memory for text must depend upon how memory is assessed. It appears, however, that accuracy will not be improved simply by using narrative texts and free recall measures of performance. The method that Maki and Swett used to collect their assessments may be a key factor, given that Pratt *et al.* (1982) requested global predictions about narrative recall performance and found that subjects were not very accurate.

We turn now to one additional factor that has been shown to affect self-assessment of comprehension: purpose for reading. Schommer and Surber (1986) provided subjects with goals for reading that required either shallow text processing (i.e., determine if the passage is clearly written) or deep text processing (i.e., prepare to teach the main points). Half of the subjects read a passage written at the 13-15th grade level and half read a passage written at the college graduate level. After reading, subjects rated their confidence in their comprehension. Then they wrote a summary of the passage and rated their confidence in the adequacy of the summary. Finally, they answered three multiple-choice questions based on the passage and rated their confidence in the correctness of their responses. Two different types of self-assessment failures were examined: passage illusion of knowing, in which the subject missed two or more items on the multiple-choice test and rated confidence in passage comprehension as high; and item illusion of knowing, in which the subject missed a particular question and rated confidence in that question as high. Note that the former measure involves an assessment of comprehension and is similar to the calibration construct of Glenberg and Epstein, whereas the latter measure involves a postdiction of test performance. On both measures, as expected, there was an interaction of processing instructions with passage difficulty, such that the highest levels of illusion of knowing occurred for subjects in the shallow processing condition who received the difficult passage. In general, goals for reading had little effect on the easy passage, but the deeper processing goal led to more accurate evaluation for the difficult passage. Verbal ability differences were also appar-

ent; subjects with higher scores on a vocabulary test showed less illusion of knowing.

A particularly intriguing aspect of the Schommer and Surber study was based on an analysis of the summaries. Three different types of summaries were identified and each was used by students with different self-assessment profiles. Subjects who “clicked” (i.e., they answered two or more questions correctly and gave appropriately high ratings of comprehension) produced summaries that were complete and accurate. Subjects who “clunked” (i.e., they answered two or more questions incorrectly and gave appropriately low ratings of comprehension) produced summaries that were missing some key concepts but were generally accurate. Finally, subjects who demonstrate passage illusion of knowing produced summaries that misrepresented the meaning of the passage, even though they included many key concepts. This suggests that poor self-assessment of comprehension may result from misunderstanding of the text rather than lack of understanding.

All of the research we have considered thus far in this section has relied on the same basic methodology. However, failure in the self-assessment of comprehension has also been demonstrated using a very different paradigm. Hosseini and Ferrell (1982) asked subjects to complete cloze tests and to rate the confidence in the accuracy of their cloze responses. Signal detection analysis revealed no relation between detectability of cloze accuracy and performance on the cloze test. Thus, to the extent that cloze performance indexes comprehension, we have one more source of evidence that mature readers are not very skilled at discriminating when they have comprehended accurately from when they have not.

### **DEVELOPMENTAL DIFFERENCES IN THE METACOGNITIVE SKILLS OF ADULT READERS**

It has been well-documented that there are developmental differences in the metacognitive skills of elementary and middle school students (e.g., Baker and Brown, 1984a, b; Garner, 1987). Older children have greater metacognitive awareness than younger children, and they are more proficient at monitoring their understanding. The tacit assumption underlying much of this research has been that such skills are fully developed by adulthood. We now know, on the basis of the research reviewed here and elsewhere, that the tacit assumption is faulty. Nevertheless, there has been very little research on the possibility of age-related changes in metacognitive skills during late adolescence and adulthood.

Kitchener (1983) believes that such changes occur, but suggests that they can best be characterized by making a distinction between metacognition and



epistemic cognition. She proposes restricting the concept of metacognition to individuals' knowledge and control of their cognitive activities while engaged in a particular task and using the term epistemic cognition for a higher level of metacognition concerned with the limits, certainty, and criteria of knowing. Thus, for example, epistemic cognition involves knowledge about the nature of problems and the kinds of strategies that are appropriate for solving them. Kitchener suggests that it is this higher level of knowledge about cognition that develops during adolescence and adulthood, as the individual shifts from viewing knowledge as absolute to viewing knowledge in terms of the context in which it is embedded (Perry, 1970).

Support for this view was provided by Ryan's (1984) study of comprehension monitoring and epistemological standards discussed earlier. Recall that students were classified as either relativists or dualists. As it turned out, the upperclassmen participating in the study were more likely to be relativists than dualists, whereas the freshmen were more likely to be classified as dualists rather than relativists. This is consistent with Perry's (1970) suggestion that adults develop a more relativistic orientation during the college years. Recall also that students who were nondualists reported standards of evaluation that reflected a comprehension orientation rather than a knowledge orientation. Thus, the study provides indirect evidence that older college students have more sophisticated criteria for evaluating their comprehension than younger college students.

More direct evidence of improvement in comprehension monitoring skills during late adolescence was recently provided by Otero and Campanario (1988), using a paradigm similar to that of Baker (1979). High school science students in grades 10 and 12 were asked to evaluate the comprehensibility of short science passages containing main-point inconsistencies without being informed of the existence of problems. The students were asked to rate the comprehensibility of the passages and to underline and explain anything that was problematic. Afterward, students were informed of the existence of contradictions and were interviewed about their responses to the passages. Several developmental differences were revealed. First, the younger students identified fewer inconsistencies than the older students. Moreover, the younger students showed a higher frequency of the illusion of knowing than the older students (i.e., they rated their comprehension as good even though they failed to identify the contradictions). Finally, the younger students were also more likely than the older students to report in the follow-up interview that they noticed the inconsistencies during reading but did not underline them at the time. The reasons they gave suggested that their regulation decisions were less appropriate; for example, they decided that the problem was unimportant or they assumed that the author must have known what he or she was talking about.

Consider now the possibility that metacognitive skills continue to improve beyond the college years or, alternatively, that they decline. Most of the existing comparisons of younger and older adults have focused on metamemory skills, and the results of these studies have been inconsistent. For example, Lachman *et al.* (1979) found that metamemory continues to improve through adulthood; Murphy *et al.* (1981) found that metamemory declines; and Perlmutter (1978) found no change. However, McCallum *et al.* (1985) found that older adults displayed less metacognitive knowledge about a concept learning task than younger adults, and Brigham and Pressley (1989) found that older adults had less metacognitive awareness about strategy choice and strategy regulation for learning vocabulary items. As Lovelace and Marsh (1985) suggest, the nature of the task demands seems to play an important role in the outcome of these developmental studies.

One study has examined directly the possibility of age-related changes in the comprehension-monitoring skills of adults. This was the major purpose of the Zabrocky *et al.* (1987) study mentioned earlier. Participants were young and old adults, with mean ages of 22 and 71. Members of both groups ranged in education level from 13-20 years. Recall that the materials were the same as those used by Glenberg *et al.* (1982), with inconsistent information conveyed either as given or as new. Subjects were told to search for contradictions and to underline any they found. After reading, they rated how well they understood the passage and whether the passage made sense. There was no effect of age on the detection of the inconsistencies, but adults with higher levels of education identified more problems than those with lower levels. There was an age effect, however, in the frequency of the illusion of knowing on passages with the inconsistency marked as new. Among those who failed to detect the inconsistencies, younger adults reported that the passages made more sense than older adults. Zabrocky *et al.* concluded that older adults evaluate their comprehension of text material as effectively as younger adults. It may even be appropriate to go beyond this conclusion, given that the older adults seemed to show better calibration of their comprehension. Moreover, that level of education was associated with superior inconsistency identification suggests either that comprehension-monitoring skills increase throughout college and beyond or that better comprehension monitors are more likely to continue their education. The first alternative is the more attractive one from a developmental perspective, but at the present time there is simply too little research to draw firm conclusions about the issue.

## ENHANCING THE METACOGNITIVE SKILLS OF ADULT READERS

In recognition of the important role that metacognition and comprehension monitoring play in academic success, much of the recent research

aimed at improving the learning and study strategies of adults has incorporated metacognitive instructional components. Although it is beyond the scope of this article to consider this line of research in detail (see the recent volume edited by Weinstein *et al.*, 1988), representative efforts to enhance the metacognitive skills of adults will be discussed. Many of the intervention approaches appearing in the adult literature are those that have been shown to be successful in research with children. Thus, we see frequent use of modeling and think-aloud techniques (e.g., Lundeberg, 1987; Nist and Kirby, 1986; Shenkman and Cukras, 1986), reciprocal teaching and cooperative learning approaches (e.g., Larson *et al.*, 1985), training in specific metacognitive strategies such as self-questioning and summarizing (e.g., Belajthy, 1986; Brozo *et al.*, 1985; King *et al.*, 1984), and self-control strategy training (e.g., Lundeberg, 1987; Shenkman and Cukras, 1986).

The recognition that thinking aloud is useful not only as a research tool for understanding comprehension and comprehension-monitoring strategies, but also as a diagnostic and instructional tool led Randall *et al.* (1986) and Nist and Kirby (1986) to advocate using think-aloud protocols with college students. Nist and Kirby suggest that one reason why many students who score well on standardized tests of reading comprehension still do poorly in content courses is that such tests measure products of comprehension rather than process. By collecting think-aloud protocols, deficits in process can be revealed (see also Randall *et al.*, 1986). Nist and Kirby also describe how college-level instructors can teach comprehension and study strategies through think-aloud and modeling procedures, much as has been done in the elementary school classroom (e.g., Duffy *et al.*, 1986; Paris *et al.*, 1984). One additional benefit of the think-aloud approach, reported by participants in several studies, is that it gives them more insight into their own comprehension processes (e.g., Block, 1986; Nist and Kirby, 1986; Randall *et al.*, 1986).

Several researchers have focused their training efforts on specific strategies that have proven effective both as comprehension-monitoring and as comprehension-fostering activities. For example, Brozo *et al.* (1985) compared the effects of training students in summarizing, item writing, and knowledge of information sources on reading test performance. College juniors and seniors took a five-week remedial reading course to improve their chances of passing a statewide college reading exit exam. Within the course context, separate groups of students were taught to write summaries (based on Day, 1980), write multiple-choice question (based on Duell, 1978), or determine question-answer relationships (QARs, based on Raphael, 1984). The group receiving the QAR training earned higher scores on both a practice exam and the actual exit exam than the group receiving summary training, and they earned higher scores than the item-writing group. The authors attribute the superiority of QAR training to the multiple-choice format of the exam, suggesting that had it been an essay exam, summarization training may have been more beneficial.

Support for this suggestion was provided by King *et al.* (1984) in a comparison of the effectiveness of training in self-questioning and summarization strategies on essay performance as well as objective test performance. Students enrolled in a developmental reading and study course participated in two training sessions, a third session in which they read an expository test passage, and a test session 48 hours later. On the objective test, the summarization group and the questioning group both performed better than a no-training control group. On the essay test, the summarization group was superior to the questioning group, which did not differ from the control group. This study illustrates clearly that it is important that there be a match between the type of processing engaged in during reading and the demands of the test.

It may also be that specific strategies are more adaptive when studying challenging materials that impose heavy demands on comprehension than when studying easy materials that can be comprehended with little effort, as a study by Belajthy (1986) suggests. Freshmen in a basic skills reading program were provided with training and practice in constructing self-generated questions. They were subsequently instructed to use the self-questioning strategy while reading and studying both an easy passage and a difficult passage; they were then tested on the material. Subjects receiving training performed better than the no-training control group on the test over the difficult passage, but they performed worse on the test over the easy passage.

Other intervention efforts have focused on providing students with a repertoire of metacognitive strategies rather than a single one. For example, Fischer and Mandl (1984) prepared a study-aid booklet for students that included instruction in reading for comprehension, storage and retrieval, and monitoring and self-testing. Students assigned to the training group worked with the study-aid booklet over a 10-day period. Students then read a lengthy expository passage in preparation for free recall and multiple-choice tests. Students who received training performed better than those in a no-training control group, but it is not clear that this difference can really be attributed to the training because the two groups received different versions of the test passage. The passage studied by the training group included interspersed self-assessment hints (e.g., test your comprehension; clarify the learning goals), whereas the passage studied by the control group was unmodified.

Larson *et al.* (1985) also provided students with instruction and practice in a "package" of metacognitive strategies. In this study the focus was on three comprehension-monitoring strategies: correcting incorrect information, detecting omissions, and detecting key ideas. Students worked together in dyads in a cooperative learning setting, alternating the roles of recaller/summarizer and listener/facilitator. They studied one passage with

their partner and a second one independently. Tests of free recall were given five days later. Subjects in the metacognitive group recalled more from passages they studied cooperatively than subjects who received either no training or elaborative training, but they recalled no more on the passages they studied independently than the control group. The emphasis on metacognitive activity clearly facilitated cooperative learning, demonstrating that students can assist each other in monitoring their comprehension. The authors were disappointed by the lack of positive transfer, concluding that "the participants are not learning improved ways of conducting these activities on their own" (p. 347). However, because the students were not instructed to use the strategies independently, they may have chosen not to do so, reverting instead to their customary and less effortful methods of studying.

We know from the developmental literature that training is most effective when it incorporates information about when, where, and why strategies should be used as well as explicit instruction in how to self-regulate the use of the strategies (e.g., Brown *et al.*, 1983). The research we have considered thus far falls short on these components of instruction, but a few more inclusive self-control training programs have been developed and tested with adults. Shenkman and Cukras (1986) tested the effects of such a program developed for underprepared college students (Shenkman, 1986). The instructional approach was called LETME (for Link, Extract, Transform, Monitor, and Extend). Its purpose was to make overt the important metacognitive activities of clarifying purposes for reading, identifying and focusing on important points, monitoring progress through self-testing, and dealing with failures to understand (Baker and Brown, 1984a).

The authors compared the effectiveness of the LETME program with separate study skills training and with nonskills comprehension practice. The separate skills group received direct instruction in the same study procedures as the LETME group, including surveying, underlining, mapping, and summarizing, but each skill was treated as a separate unit without explanation of underlying strategies or reference to self-regulation. The study was conducted over a 12-week period in a developmental reading and study skills course for community college students. Learning from text was assessed by asking students to read a sociology passage and answer objective and essay questions. Metacognitive awareness was assessed by asking students to describe as specifically as they could how they went about reading and studying the selection. Subjects in the LETME group reported engaging in more metacognitive activities than subjects in either of the other groups. They also performed better than both groups on the essay test and better than the nonskills group on the objective test. On none of the measures was the separate skills group superior to the nonskills group. Thus, it appears that the LETME training was effective in enhancing metacognitive awareness and test perfor-

mance, presumably because it gave students a strategic, goal-oriented approach to the study process.

Most of the intervention efforts with adults have been targeted at underprepared or unsuccessful college students. However, the research reviewed in this paper makes it clear that the “average” student is also an excellent candidate for explicit metacognitive-strategy instruction. In fact, Lundeberg (1987) has shown that students whose undergraduate performance was so successful that they gained entry into law school also benefited from such training. Lundeberg conducted a series of studies to teach law students to apply the same strategies reported by expert readers of legal cases (see earlier discussion of this work). In the first experiment students were provided with guidelines explaining the structure of the legal case, where to locate important information, and so on. Students who received the guidelines performed better on both multiple-choice and short-answer questions based on the case. In the second experiment, Lundeberg compared students receiving no training, guidelines only, or guidelines with self-control training. The self-control training was provided over a three-hour period as part of a course on reading and learning strategies for law. The focus was on making students aware of the usefulness of specific strategies, and they were taught to self-monitor their understanding by asking questions about the case. The training included modeling, practice, feedback, and discussion about cognitive strategies. The self-control-plus-guidelines group earned higher test scores than the other two groups, but the difference was only reliable in contrast to the group receiving no guidelines. In a third experiment, the same subjects were tested after two months of experience in law school. Students who received the training showed continued improvement in their scores, suggesting that they were continuing to use the trained strategies. Moreover, the difference between guidelines with training and guidelines alone was now significant. Thus, the study illustrates that self-control strategy training is effective in helping even mature intelligent readers learn from text.

Although the primary thrust of instruction in metacognition and cognitive monitoring has been to improve the skills of students, it is important not to lose sight of the potential value of metacognitive training for adults in nonacademic contexts. Consider, for example, a study that demonstrates an important “real world” application of instruction in comprehension monitoring. Robinson and Whitfield (1985) tested the effects of providing medical patients with specific strategies for checking their understanding of instructions and advice given by their physicians. Subjects in the experimental group produced more questions and comments in their interactions with their physician than the control group, and they showed a better understanding of the recommended treatment. Interventions at the workplace may also be appropriate; recall that the literacy-related metacognitive skills of superi-

or job performers are considerably stronger than those of less successful job performers (Mikulecky and Ehlinger, 1985; Mikulecky and Winchester, 1983).

## SUMMARY AND CONCLUSIONS

The purpose of this article was to provide an overview and synthesis of the current literature on metacognition and comprehension monitoring among adult readers. The paper was organized around three major research questions: (1) How do adults conceptualize their own comprehension-fostering and comprehension-monitoring activities? (2) How effectively do adults evaluate and regulate their ongoing efforts to understand? (3) How successfully do adults assess the final products of their comprehension efforts? Cutting across these broad issues were questions concerning the possibility of metacognitive differences as a function of reading ability, academic success, domain expertise, developmental level, and task variables.

By way of summary, let me offer a brief answer to each of the questions. Adults' conceptions of how they comprehend and how they monitor their comprehension are quite variable. In general, those who have more expertise, who are better readers, and who are more successful students seem to have greater awareness and control of their own cognitive activities while reading. Adults do show evidence that they evaluate and regulate their ongoing efforts to understand, but there is clearly considerable room for improvement in these skills. The process measures provide a more optimistic picture than the error detection measures. It is easy enough to explain away low detection rates when subjects are not set to identify problems; one can appeal to Grice's (1975) cooperative principles or postulate the spontaneous use of fix-up strategies. However, it is difficult to understand why so many readers fail to report problems embedded in texts even when they are specifically instructed to do so. Finally, adults are remarkably unsuccessful at assessing how well they have comprehended a text and whether or not they are ready to take a test on the material. We need to seek ways to improve students' self-assessment skills, as poor calibration appears to be a widespread phenomenon, occurring across a variety of text types, test types, and delay intervals. Providing students with self-testing opportunities was shown to be an effective technique, but in order for students to achieve control of their own learning activities they should not be dependent on instructor-provided questions. However, it is not clear whether student-generated questions would have the desired effect, given the Glenberg *et al.* (1987) finding that questions are only effective if they closely approximate the actual test questions.

Across the three research areas, reading ability differences appeared quite consistently. Virtually all of the self-report studies revealed that better

readers were more metacognitively sophisticated than poorer readers, as did the comprehension-monitoring studies and the self-assessment study of Schommer and Surber (1986). Whether weak metacognitive skills are a cause or a consequence of weak reading skills is impossible to determine on the basis of this research. A related concern is the direction of causality for the often-found association between metacognition and academic or job performance. However, well-designed training programs that provide instruction in comprehension strategies and self-regulatory skills do produce improvements in test performance; this offers promise for better and poorer students alike.

Finally, the evidence of age-related changes in the metacognitive skills of older adolescent and adult readers is intriguing. Not only is this consistent with the hypothesis of qualitative differences in conceptions of knowledge (e.g., Kitchener, 1983), it also is consistent with Chall's (1983) stage model of reading. Chall proposes that the highest stage of reading skill is reached during the college years, a stage characterized by reading to integrate one's knowledge with that of others and to create new knowledge. Such reading clearly requires the use of multiple, higher-level criteria for evaluating comprehension. Whether age-related differences are independent of educational experience is an important unanswered question. Given the high proportion of older "nontraditional" students currently enrolled in our colleges and universities, research addressing this issue would be timely and feasible.

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