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ABSTRACT

Drawing upon Piagetian and Vygotskian developmental theories, philosophical examinations of the nature of argument and explanation, analyses of classroom and Socratic dialogues, and cooperative classroom structures, this paper examines how cooperative learning can influence individual knowledge acquisition. The paper first reviews some of the theoretical claims concerning a variety of group learning procedures and the evidence that supports their efficacy. Claims discussed include the following: (1) group participation aids learning, (2) group settings force learning with understanding and thus produce conceptual changes, and (3) individual thought processes originate in social interaction. The paper then examines a program of guided cooperative learning--reciprocal teaching, which combines expert scaffolding, guided practice in applying simple concrete strategies, and cooperative learning discussions. In particular, the paper explores the impact of the program on the listening and reading comprehension strategies of first grade students. The paper concludes that reciprocal teaching is a successful method of improving both listening and comprehension, and discusses possible extensions of the techniques to instruction in specific content areas. Fourteen pages of references are also included. (FL)

CENTER FOR THE STUDY OF READING

Technical Report No. 372

# GUIDED, COOPERATIVE LEARNING AND INDIVIDUAL KNOWLEDGE ACQUISITION

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Abstract

In this report we consider how cooperative learning can influence individual knowledge acquisition. Research from a variety of different traditions is reviewed, including both Piagetian and Vygotskian developmental theories, philosophical examinations of the nature of argument and explanation, analyses of classroom and Socratic dialogues, and cooperative learning classroom structures. In the light of this background, we consider a program of guided cooperative learning, Reciprocal Teaching, and its impact on the listening and reading comprehension strategies of grade school children. In particular, we concentrate on how to set up reciprocal teaching groups to foster the emergence of active listening strategies in very young children, first graders. Reciprocal Teaching, which combines expert scaffolding, guided practice in applying simple concrete strategies, and cooperative learning discussions, is a successful method of improving both listening and reading comprehension. Extensions of the techniques to instruction in specific content areas, such as elementary science and mathematics, are discussed.

# Guided, Cooperative Learning and Individual Knowledge Acquisition

The recent spurt of interest in children's learning in groups is fuelled by research stemming from several different traditions. These include Piagetian (Doise & Mugny, 1984) and Vygotskian (1978) theories in developmental psychology, philosophical examinations of the nature or argument and explanation (Grize, 1982; Kneupper, 1978; Toulmin, 1958; Von Wright, 1971), observations of classroom dialogues (Barnes & Todd, 1977; Cazden, 1984; Mehan, 1979) and a variety of cooperative learning environments (Aronson, 1978; Johnson & Johnson, 1975; Sharan, 1980; Slavin, 1983). Despite this upsurge in the amount of research, however, fundamental questions such as the following remain unanswered: Does participation in a group problem-solving setting influence individual learning, and if so, in what way? What are the essential functions of groups that encourage learning? What role, if any, does an explicit instructional goal play in such settings?

In the first part of this report, we discuss some of the theoretical claims concerning a variety of group learning procedures as well as the evidence that supports their efficacy. In the second part of the paper, we concentrate on reciprocal teaching, an expert-led cooperative learning procedure developed

to improve children's understanding of complex text (Brown & Palincsar, in press; Palincsar & Brown, 1984).

## Learning and Understanding

### Learning: A Question of Degree

Determining whether group participation aids learning, without first defining "learning," would be difficult indeed. "Learning" is a term with more meanings than there are theorists. However, most would agree on some basic distinctions; that, for example, there is a great deal of difference between the addition of a new fact to the knowledge base, and conceptual upheavals in understanding of the form similar to theory change in the history of science (Carey, 1985; Kuhn, 1962).

Learning clearly admits of degree. For example, one traditional criterion of learning is that a certain body of information can be regurgitated sometime after it has been read, heard, or discussed; indeed, this is often what is tested in examinations. Unfortunately, preparation for tests of learning that emphasize retention of facts often leads to the acquisition of "inert" knowledge (Whitehead, 1916) encapsulated in such a way that it is rarely accessed again unless a specific cue to activation, such as an expected examination question, is given (Brown & Campione, 1981, 1984). The information fails to become part of a usable store of knowledge. In a very real sense, the learner has not established ownership of that knowledge which

would afford him flexible access to it, access that would enable him to adapt, apply, update, or modify it at will.

A qualitatively different level of knowledge acquisition requires the assimilation of new knowledge so that it is owned by the learner, readily accessible, and potentially applicable to related but novel situations. In such circumstances, the new information becomes part of a workable knowledge base and can be applied widely, for better or worse.

Yet another level of learning involves modification or adaptation of usable knowledge in the face of new experiences. In this case, a generalizable body of knowledge already exists; an incompatible new experience forces alteration, modification, refinement, or restructuring. And then there is true theory change in which a stage-like change in fundamental modes of thinking restructures knowledge throughout the system. Controversial as such stage-like notions may be (Carey, 1985; Case, 1985; Fischer, 1980; Flavell, 1971), most would agree that they are fundamentally different in kind than the mere acquisition of a new fact. Determining whether or not group problem-solving experiences influence individual learning depends upon what level of change we examine.

## Understanding and Conceptual Change

One of the most common claims about group settings is that they force learning with understanding and therefore are likely to foster conceptual change. Situations that result in

automatization, ritualization or routinization of skill (situations in which speed is emphasized at the expense of thought), contrast with situations that encourage reflection. Conceptual change results from situations that emphasize the purpose of procedures rather than blind drill and practice, even when that drill and practice is devoted to appropriate procedures (Bereiter & Scardamalia, in press; Brown, 1978; Brown, Bransford, Ferrara, & Campione, 1983; Resnick, in press). Group settings are regarded by their adherants as ideal for encouraging a consideration of the reasons why one acts.

Conceptual understanding and adaptive change are fostered in situations which encourage dissatisfaction with the existing state of knowledge; change is unlikely when the status quo is unquestioned. Environments that encourage questioning, evaluating, criticizing, and generally worrying knowledge, i.e., taking knowledge as an object of thought, are thought to be fruitful breeding grounds for restructuring. Dissatisfaction leads to mental experimentation, evaluation leads to uncertainty, insecurity is accentuated by questioning and criticism, and group settings are said to foster questioning and criticism, overt or implied (Hatano, 1982; Inagaki & Hatano, 1983). Change is more likely to occur when one is required to explain, elaborate, or defend one's position to others (or sometimes to oneself). The

burden of explanation is often the push needed to make a learner integrate and elaborate knowledge in new ways.

Social Genesis of Individual Understanding

An even stronger claim to the above position, that social settings foster conceptual change, is that individual thought processes actually originate in social interaction, a developmental theory most closely identified with Vygotsky (1978), but not unique to him (Brown & Reeve, in press). This is a controversial position. There is a well respected tradition in the developmental psychology of learning that affords a very minor status to the role of other-direction, either in the form of the influence of intentional teachers or informal social settings. According to such theories short of supplying a source of imitation, social agents play little part in inducing conceptual change. This position, usually attributed to Piaget (erroneously), holds in the extreme that all "meaningful" conceptual change is self-directed. There can be little doubt that human beings, even the smallest, maybe especially the smallest, are intrinsically motivated to understand the world around them. Some argue that learning is guided by systems of internal structures, principles, or constraints that seek support in the environment for their growth and development. In addition, children come equipped with a propensity to extend knowledge by systematically monitoring naturally occurring variations and the results of their own active experimentation

(Gelman & Brown, in press-a). Herein lies the foundation of such metaphors as the tireless explorer (Chukovsky, 1968) or the child as scientist (Piaget, 1950) central to many conceptions of childhood thought. The child is seen as essentially a self-directed learner seeking data to test and modify his or her current theories and hypotheses of how things work (Carey, in press; Gelman & Brown, in press-a; Inhelder, Sinclair, & Bovet, 1974; Karmiloff-Smith & Inhelder, 1974/75).

In contrast, there are theories of cognitive development that go to the opposite extreme and emphasize other-direction almost exclusively. This position is usually associated (also erroneously) with Vygotsky (1978). According to this stereotype, conceptual development has an essentially social genesis. Children continually observe and participate in group activities; conceptual change is essentially a process of internalizing cognitive activities originally experienced in the company of others. A coordination of the two positions comes somewhat nearer the truth (Brown & Reeve, in press; Gelman & Brown, in press-b).

Both Vygotsky and Piaget, usually blamed for one or other of the extremes, balanced both social and individually directed learning to some extent, although they chose to focus primarily on one pole or the other. For example, in his early work Piaget considered the role of social experience in cognitive development. In particular, Piaget regarded peer interactions as an ideal

forum for helping transitional children take the leap to a higher level of understanding. A group of peers, who not only fail to accept one's own view but actually hold opposing opinions, must cause reflection in a reasonable child. Such experiences help children "decenter" their thinking from one particular egocentric perspective, thereby enabling them to consider multiple perspectives. Group discussions coordinate opposing egocentric views and enable a more mature consensus to emerge. According to this view, "social interaction is a necessary condition for the development of logic" (Piaget, 1976a, p. 80). The process (the group interactions), as well as the product (the solution to the problem), are internalized as part of the child's emergent thinking repertoire, "that human intelligence develops in the individual as a function of social interaction (is) too often disregarded" (Piaget, 1967, pp. 224-225).

Although Vygotsky (1978) considered self-directed experimental play, notably in his treatment of tool use, he is clearly the developmental theorist who most emphasized the essentially social nature of individual cognition. Vygotsky argued that thinking is a social activity, initially shared between people, but gradually internalized to reappear again as an individual achievement. In short, for Vygotsky, individual thinking is essentially the re-enactment by the individual of cognitive processes that were originally experienced in the company of others. The fundamental process of development is the

gradual internalization and personalization of what was originally a social activity.

Although all social settings in which the child might participate do not have an explicit instructional goal, many do, especially those led by adults. Children commonly find themselves in situations where an adult usurps a teaching function. It is this natural instructional role that is a mainstay of development. As Wertsch (1984) points out, the Russian word obuchenie actually means the "teaching-learning process," and it is this symbiotic function that is central to Vygotsky's theory.

It is important to note that the teaching function of interactional situations need not be explicit, or be the central agenda of the activity. A group problem-solving setting can provide a learning forum for its members, even though the guiding activity is successful problem solution, regardless of individual contributions or the potential for personal development (Kelley & Thibaut, 1969). Similarly, in many informal apprenticeship settings, the teaching function is a minor part of the total social activity. In many cultures, children are initiated into adult work activities such as weaving (Greenfield, 1984), tailoring (Lave, 1977), marketing (Lave, Murtaugh, & de la Rocha, 1984), etc., without explicit formal instruction (Cole & Bruner, 1971; Cole & Scribner, 1975). The expert members of the group have as their main agenda the task of weaving, tailoring, etc.,

and are only secondarily concerned with initiating the novice, or overseeing the progress of the apprentice.

The instructional role is explicit when mothers instruct their children or when teachers lead classroom discussions. Although we will discuss the distinction between implicit and explicit teaching in a subsequent part of the report, at this point we would like to emphasize Vygotsky's claim that expert-led social interactions have a central place in learning and provide a major impetus to cognitive growth. According to Vygotsky (1978), teaching-learning, or obuchenie, creates development, which in turn determines the level at which teaching-learning can be directed. Learning and development are interwoven in the complex spiral pattern that is intellectual growth.

Piaget and Vygotsky, not to mention Binet (Binet, 1909; Brown, 1985) and Dewey (1910), all place heavy emphasis on guided learning as an impetus to developmental change. The key concept is internalization; that which is witnessed in social settings becomes harnessed as individual cognition. Although these theories are seductive, progress demands more exact specification of what processes are internalized and how. Although certain roles must be prime candidates for translation from the external to the internal world, everything the child witnesses is not internalized. Social interactions do not always create new learning; some parents and teachers are surely more effective than others; peer interactions vary enormously, with only some

creating ideal learning experiences. We need a great deal more examination of such questions as: (a) What kinds of interactions are maximally effective at inducing cognitive growth? (b) To what extent do social collaborations lead to independent competence? (c) What are the mechanisms underlying internalization? (d) Can optimal interactions be orchestrated deliberately in instructional settings? In short, theorists such as these have provided a blueprint for research, but the variables embodied in the concept of supportive contexts need to be delineated in far greater detail (Brown & Reeve, in press). In the next section, we will discuss research on group problem-solving which helps provide some of the necessary specification.

## Cooperative Learning

The term, cooperative learning, is most closely associated with research in educational psychology concerned with alternatives to traditional classroom organizations. Although the term has been used to refer to cooperative behavior, or the division of labor within tasks, the primary interest has been in motivation and incentive (Slavin, 1983); cooperative, competitive, and individualistic incentive structures are compared and contrasted (Johnson & Johnson, 1974, 1975). In-depth consideration of the actual thinking processes affected by such settings is rare. Researchers have been mainly concerned with whether or not cooperative settings result in better products, learning outcomes, than competitive and individualistic

environments. Indeed, Sharan (198. ..as argued that even these products tend to tap learning of basic content of the interacted-upon material at the expense of higher-level thinking such as "elaboration of ideas, analysis and problem solving" (Sharan, 1980, p. 255), the type of thinking processes that should be exercised in group discussions.

The main findings from this literature indicate that cooperative settings do result in marginally significant improvement in outcome measures (Sharan, 1980), and three explanations of this effect are posited (Swing & Peterson, 1982; Webb, 1984). First, giving explanations is positively correlated with achievement. But we must be cautious in interpreting this finding. Even though care may be taken to partial out starting ability, ability is not synonomous with knowledge. It could be that those giving explanations are those who already know the content and, therefore, it is scarcely surprising that they score well on subsequent tests of that content. Second, receiving help is somewhat related to achievement; one would like to know, however, if the presence of an effect is influenced by the type of help and accuracy of information that is received, surely an important factor. And third, it comes as no surprise that receiving no answer to one's questions is firmly related to poor outcomes. This pattern of findings is intriguing and brings into high relief the importance of <u>explanation</u> in group learning. What is needed is a more fine-grained examination of the

explanation process itself. In the next section we will consider in some detail two much-discussed aspects of group explanation and discussion, the role of support and the role of conflict.

## The Role of Support

Groups are said to provide social support for the efforts of their members. Studies of group discussion often report that more work goes into motivational factors, such as providing encouragement, rewards, and camaraderie than into actual problem solving (Barnes & Todd, 1977). But a great deal of cognitive support is provided in group settings. Let us next review the main evidence to support this claim.

Culturally appropriate participant structures. Microethnographic studies of group constellations in the classroom have examined the participant structures that modulate interaction. Erickson and Shultz (1977) describe participant structures as constantly changing, interactionally constituted environments marked by specific sets of rules for speaking, listening, turntaking, etc. Some participant structures are more hospitable to young children than others, and this is especially true when they come from ethnic groups other than the dominant White culture. For example, the most typical participant structure in grade schools is that of "simple reciprocation" (Dunkin & Biddle, 1974; Mehan, 1979)--the teacher asks a question to which she clearly knows the answer; a student is called upon; and the teacher evaluates the response explicitly or implicitly

(by turning to another respondant). These teacher-directed discussions are perceived at best as awkward because they put an individual child on the spot, and at worst culturally inappropriate, clashing with accepted norms of social interaction. Studies with native Hawaiian (Au, 1980; Boggs, 1972), Odawa (Philips, 1972), Cherokee (Dumont, 1972), and Athabascan (Van Ness, 1982) Indian children have all shown these interaction patterns to be culturally unsuitable.

Simple reciprocation routines result in considerably depressed student participation, even apathy. Indian children prefer activities based on collective rather than individual performance. For example, an Odawa Indian teacher lessened her students' feelings of alientation by addressing them privately or in small groups; she avoided calling across the room to individual children who must then perform independently and in public. The Odawa teacher assisted children at their request and with reasonable concern for privacy (Mohatt & Erickson, 1982; Philips, 1972). Similarly, teachers experienced with Native Hawaiian children capitalized on a culturally well-practiced routine to direct reading groups (Au, 1980). The participant structure that emerged closely resembled "talk-story," a common Hawaiian group-activity of collectively telling jokes and stories. In talk-story, two or more speakers collaboratively produce the narrative, overlapping and intermingling turns at will. The resultant classroom reading ritual that permitted

co-construction and co-elaboration resulted in far greater academic engaged time (Au, 1980) and has been cited as a primary reason for the success of the Kamehameha Early Education Program. Similarly, teachers sensitive to Black Appalachian questioning and narrative style have improved reading outcomes, as well as feelings of personal competence among their students (Heath, 1981).

Certain participant structures have been amply demonstrated as culturally inappropriate for a variety of ethnically different groups. What has not been proven is that simple reciprocation is culturally appropriate to the dominant culture. Indeed, many have argued against this claim (Mehan, 1979), particularly when the children in question are young, poor, or academically delayed (Brown, Palincsar, & Purcell, 1985). Collaboration may be the preferred mode for many children. Some of the benefits of cooperative learning will be described next.

Shared responsibility for thinking. In group problem-solving situations, the thinking load can be distributed among the members, with both cognitive and emotional consequences.

> What happens at the emotional level is that the group sustains the general emotive tension because it "shares out" the effort of thinking and reduces the anxiety produced by having to keep the argument going; each person has to think and say only one "piece" of the discourse, which can be used to construct another. This piece then comes back in

more elaborated form in someone else's statement, --- and can be used later at a level of greater complexity. (Pontecorvo, 1985, ms. p. 3)

For example, consider a group of English 13-year-old working-class children helping each other establish a point about littering, each providing a piece of the argument.

David: I think bigger fines should be imposed for the people who don't obey the country laws and thereby spoil the countryside.

Jonathan: Yeah

Marianne: . . . by leaving . . .

Jonathan: . . . by dropping litter . . .

Marianne: . . . and broken glass.

(Barnes & Todd, 1977, p. 33)

Or a group of Italian 10-year-olds discussing why bread gets stale.

Sa: Because, because it is closed.

Ma: Because it is too closed.

Val: If you leave it . . .

Ric: If it is closed, it keeps because . . .

Sa: All the soft parts . . .

Val: Actually, if you leave it on the sideboard, it gets hard because the air hardens it.

Sa: It absorbs its softness.

(Pontecorvo, 1985, ms. p. 3)

Not only can the role of argument construction be jointly managed, but group settings commonly allow individuals to share out potential argument roles and strategies. For example, social psychological studies of group dynamics identified a variety of spontaneous roles adopted by group members (Bales, 1950; Dashiell, 1935; Kelly & Thibaut, 1954; Shaw, 1932). The most common roles are those of: (a) the executive or doer, who designs plans for action and suggests solutions; (b) the skeptic or critic, who questions premises and plans, usually those of others; (c) the didactic role or educator, who takes on the burden of explanation and summarization for less involved members of the group; (d) the record keeper, who keeps track of what has passed; and (e) the conciliator, who resolves conflicts and strives to mimimize interpersonal stress. One of these roles might be appropriated by an individual member (Pontecorvo, 1985), or role assumption might fluctuate over time. In both cases, however, the roles are separated so that each participant need play only one of them, thus reducing the cognitive load for upgrading the level of problem-solving for any one individual.

Not only are such spontaneous role assumptions naturally occurring outcomes of setting people the tasks of combining their talents to solve problems, but the division of labor can be artificially legislated to good instructional effect. Many successful adult dyadic-learning procedures require that one member of the learning pair acts as executive, thinker, or

planner, while the other acts as critic or evaluator (Bloom & Broder, 1950; Frase & Swartz, 1975; Whimbey & Lochhead, 1978). And separating the role of learning leader from learning listeners works well in group problem-solving with young children in classroom settings (Yager, Johnson, & Johnson, 1985).

Shared expertise. It has often been argued that a major advantage of group over individual learning is that any group will benefit from the increased range of expertise of its members' collaborative knowledge. Shared expertise is the underlying concept of cooperative learning procedures such as Aronson's (1978) Jigsaw method. Children are divided into groups of five or six, each group held responsible for a large body of material on which they will eventually be individually tested. The material is also divided into five or six parts. For example, the life history of Thomas Edison might be segregated into sections covering childhood, first accomplishments, major setbacks, later life, and world events during his lifetime. Each member of the team is assigned just one section to study. Members with the same assignment (across groups) meet first in expert groups to discuss their common responsibility. Now expert, the subject-matter specialists return to their cooperative learning groups and pass on their information. Each child is expert in one area. The groups are responsible for covering all the material. What happens?

Unfortunately, the written reports leave us somewhat in the dark. Although we are told that children are given training to improve communication and tutoring skills, and that the groups monitor their own interpersonal interactions, we are given little detail on the actual group mechanisms. Furthermore, Sharan (1980) argues that tests of independent achievement following Jigsaw participation have tended to be in the form of multiple choice questions of retention of content rather than tests of improved thinking skills, such as argumentation and elaboration. A further look at cooperative learning methods [such as Jigsaw, Student Team Achievement Division (Slavin, 1983); Teams-Games-Tournaments (DeVries, Slavin, Fennessey, Edwards, & Lombardo, 1980); Group Investigation (Sharan & Sharan, 1976); and the Learning Together Model (Johnson & Johnson, 1975)], where the concentration is on what the students actually do in these groups, would help pinpoint what thinking processes are practiced and, therefore, what type of improvement in higher order skills might be expected. Improved retention of the content of a particular set of materials, although desirable, may not be the primary benefit of group participation. Practice discussing, defending, and evaluating one's opinions and those of others may result in improved ability to learn about future text content, a learning to learn effect that would be far more beneficial than gains on any one set of factual material (Brown, Campione, & Day, 1981; Brown, 1985).

Models of cognitive processes. Another advantage of learning in social settings is that the roles of executive, skeptic, bookkeeper, educator, etc. are executed overtly. Not only does each member have less of the thinking burden placed on his shoulders, but he is also privileged to a dramatic enactment of each of the roles, roles that correspond to thinking strategies that he must subsequently come to perform himself, along and covertly. In the course of group argument and explanation, the individual member is likely to witness a whole variety of epistemic operations, such as referring to context, past knowledge, data or general principles, defining the problem, isolating important contributing variables, evaluating progress, etc. Even grade school children observe some basic rules of formal argument, requiring justifications, warrants, and backings (Kneupper, 1978; Toulmin, 1958) for a particular position (Pontecorvo, 1985).

Barnes and Todd (1977) identified twelve recurrent cognitive strategies that their junior high school students routinely used in group discussions of physical and social science problems. These include an elaborated set of causal reasoning activities such as proposing and evaluating causal explanations by asking such questions as "Why necessary?" and "How possible?" "Answers to questions of the first type can be used for making predictions; answers to questions of the second type for making retrodictions" (von Wright, 1971). Barnes and Todd also report

frequent recourse to arguments concerning the (in)validity of a premise, attempts to justify premises with warrants and backings (Toulmin, 1958), application of general principles to cases, elaboration, restatement in different terms, negation, and evaluation. Often the premises are weak, and the logical progression of the argument ill-formed, but primitive precursors of argument structure can be seen even in quite young children (Bos, 1937; Paley, 1981). Sharing the burden not only permits a collaborative level of functioning far in advance of the individuals' ability to maintain discourse cohesion, but it also provides important modelling of essential argument forms.

## The Role of Conflict

Confrontation causes change. Developmental psychologists of a variety of theoretical persuasions agree that confrontation, especially conflict, is the great catalyst of change, a community confidence not shared by psychoanalysts. In this section, we will consider the subject of confrontation in groups.

Elaboration. Social settings provide an audience for an individual's attitudes, opinions, and beliefs, and audiences can request clarification, justification and elaboration. A well-known anecdote is that of the teacher, confident of her own mastery, who attempts to explain a complex theoretical point. The class is mystified and asks for another explanation, which is given. The class is still uncertain and asks for a third recitation. With the third explanation comes understanding, on

the part of the teacher that is. Explaining and justifying a premise or belief to an audience can cause uncertainty and even conflict. It is in the resolution of this uncertainty that change is said to occur.

The skeptic or critic role in group discussion has been accorded special status, some arguing that by forcing the group to defend or elaborate solutions, a more mature resolution will emerge. Pontecorvo (1985) reports repeated examples of grade school children playing this positive role of demanding a better understanding. For example, ten-year-old En will not accept the mere fact that pasta is in the water as an explanation of why it expands. En: "Yes, but the explanation of being in the water is not a logical one. I want to know how it [the water] gets in [the pasta]." Similarly, on the same topic, En demands, "Yes, they say it gets softer, but they must have some idea in order to say it gets softer; how does it get softer?" And again En: "But what does the water do to spaghetti to make it soft." Finally, in a telling judgement of the level of answers he is getting, En contents, "It is possible for everyone to speak of their ideas without giving an explanation!" En wants elaboration, justification, warrants, and backing and he won't be satisfied with less.

In the Barnes and Todd (1977) dialogues between 13-year-olds, requests for expansion are frequent. In the excerpt below, a group is considering how bird eggs are fertilized.

Donald: It's fertilized in the body; it must be. Of course it's fertilized in the body.

Louise: What makes you think so?

Helen: It must be.

David: 'Cos it wouldn't get back through.

Helen: It can hardly get through the damn shell, can it?

(Barnes & Todd, 1977, p. 30)

Teresa, in another group, follows up on Nicola's description of why a cork will be ejected from a bottle placed in a bell jar with the following requests and support for elaboration:

Teresa: So what made it possible for the cork to come out then?

Nicola: Well, it didn't actually come out, it were sort of forced out really.

Teresa: Yeah?

Nicola: And there were all pressure, all the way round it, all them little particles floating about.

Teresa: Yeah?

Nicola: They were forcing the cork to come out anyway.

Teresa: Mm!

Justifications, warrants, and backings. In addition to requesting elaborations and corroborations, group members may call on the discussion leader to "back" his arguments, not with additional data, but with warrants attesting to the pertinence, credibility, or legitimacy of the data already proferred.

"Rules, principles, inference-licenses are required that show that given the data provided, the step to the original claim or conclusion is an appropriate or legitimate one" (Toulmin, 1958, p. 98). The distinction is between corroborative data on the one hand, and warrants or backings for that data on the other. This is similar to the difference between a general law and a particular case. Structurally, the argument progresses from statements of factual data, statements of the warrants or authority for that data, to by backings for those general warrants which can again be expressed in the form of categorical statement of facts to support the warrant (Toulmin, 1958). Group members force the discussion leader to provide warrants and backings to the legitimacy of her arguments, thereby elaborating, extending, and providing it with coherence. At a very simple level, children follow these argument structures in their dialogues. Consider first a group of American kindergarten children discussing the Black Santa.

Rose: I saw a black Santa Claus.

Kenny: He can't be black. He has to be only white [questions fact].

Rose: I saw him at Sears [factual support].

Warren: Santa Claus is white [support with general law].

Wally: If you're black, Santa Claus is black, and if you're white, Santa Claus is white. But I think he's white [general principle and personal experience].

Teacher: But aren't you black, Wally?

Wally: I know. But I see Santa Claus, and he's white [personal experience].

Tanya: I haven't seen a black Santa Claus, but I know he could be there, because everything comes in black and white. (She looks around.) Or Japanese. Or Chinese [questions personal experience with recourse to general principles].

Eddie: No. I know only one color he should be. White. I saw him in the store [personal experience].

Teacher: But Rose saw a black Santa.

Eddie: He could have been dressing up like a black Santa [justification for exception].

Wally: Did he talk, Rose? Maybe he had wires [request for backing].

Rose: He said, "Ho, ho, ho!"

Wally: I think he was real.

Tanya: See, someone must be dressed up to be a certain kind of Santa Claus. If they need a white one, he comes out. If they need a black one, he comes out [resolution of conflict].

(Paley, 1981, pp. 91-92)

Next consider a group of Italian seven-year-olds discussing where tap water comes from. They have already established that in Florence, where they live, the water comes from the river

Arno. In this excerpt, they request and discuss warrants and backings for the implication they have drawn that all tap water comes from the Arno.

And: But there isn't just one Arno in the whole world [questions warrant for assumption].

Gin: How does he know there is not just one Arno, that there are a lot of rivers, he hasn't been everywhere [questions factual backing].

Bar: He imagines them. He didn't need to go everywhere to find out how many rivers there are [appeal to general principles to provide foundation for the emerging many rivers hypothesis].

Bar: In Florence there is only one [limits the general principle].

T: But near where I live there is another [antithesis to limitation].

Be: It must be the one I have seen [brings in corroborating personal experience].

Ef: He knows there are many rivers in the world. There are many rivers in the world because the world is large enough for there to be many rivers, so there are many rivers [appeal to general principle ad rem which provides further backing for many rivers hypotheses].

(Adapted from Pontecorvo, 1985, pp. 9-10)

Alternative points of view. The classic case of confrontation involves conflicting points of view. For example, let us return to the kindergarten children who have started to act out "Jack and the Beanstalk" when Wally and Eddie disagree about the size of the classroom rugs.

Wally: The big rug is the giant's castle. The small one is Jack's house.

Eddie: Both rugs are the same.

Wally: They can't be the same. Watch me. I'll walk around the rug. Now watch--walk, walk, walk, walk, walk, walk, walk, walk, walk—count all these walks. Okay. Now count the other rug. Walk, walk, walk, walk, walk. See? That one has more walks.

Eddie: No fair. You cheated. You walked faster.

Wally: I don't have to walk. I can just look.

Eddie: I can look too. But you have to measure it. You need a ruler. About six hundred inches or feet.

Wally: We have a ruler.

Eddie: Not that one. Not the short kind. You have to use the long kind that gets curled up in a box.

Wally: Use people. People's bodies. Lying down in a row.

Eddie: That's a great idea. I never even thought of that.

(Paley, 1981, pp. 13-14)

Eddie and Wally readily settle their disagreement by recourse to factual proof. Similarly. the children, after reading "Stone Soup" and missing the point of the story, demand proof that stones melt by actually boiling some. Some argue that the stones are smaller (have melted), others that they are just the same.

Ellen: They're much smaller.

Fred: Much, much. Almost melted.

Mickey: Draw a picture of them.

Teacher: And cook them again? All right.

The children then compare the picture (large) and the stones (small) and declare them to be melted. The teacher intervenes.

Teacher: I know they seem smaller, but it's very hard to match stones and patterns. Is there another way to prove whether the stones have melted?

(There is no response. Clearly I am after the "right" answer, but the children have enough proof that the stones have melted.)

Teacher: Let's weigh them on this scale. How much do they weigh?

Everyone: Two

Teacher: Two pounds.

Lisa: Do we have to cook them again? They'll just keep melting.

(After a short period, we weigh the stones again.)

Eddie: Still two. But they are smaller.

Teacher: They weigh the same. Two pounds before and two pounds now. That means they didn't lose weight.

Eddie: They only got a little bit smaller.

Wally: The scale can't see the stones.

(Paley, 1981, pp. 17-18)

The issue of conflicting points of view has been studied most rigorously by the so-called Neo-Genevans (Inhelder, Sinclair & Bovet, 1974) and Social-Genevans (Doise & Mugny, 1984), who have extended Piaget's concern with peer group learning. Their model experiment consists of dyads or small groups of children trying to solve classic Piagetian tasks. The majority of studies concern various forms of perspective-taking or conservation tasks designed for children transitional between preoperational and concrete operational thought (5-7 years of age). In the more recent studies (Perret-Clermont, 1980), fairly strict measures of reliability and generalization are taken as posttest measures of individual learning. In the main, such studies show that collaboration leads to enhanced performance and is particularly beneficial for children entering the experiment with partial understanding; collaboration pushes them over the edge, as it were (but see Russell, 1981, 1982a for an alternative explanation). The research agenda, given these findings, becomes one of systematically establishing what it is in the group setting that accelerates learning.

We can summarize an extensive literature (see reviews by Doise & Mugny, 1984; Perret-Clermont, 1980), by saying that the superiority of collaborative cognition cannot be accounted for simply in terms of the less informed children imitating those who already know. Groups result in "fundamental cognitive restructuring," not mere temporary compliance or imitation. Furthermore, research also clearly indicates that not all social interactions automatically lead to individual cognitive growth. The facilitative effect of collaborative cognition depends upon a number of key factors, the first of those being the initial competence of the child. Only when a child has a partial grasp of the concept in question will peer interactions be effective. Second, the social status of the children is important. One member of the group must not be so dominant that the result is pseudoconsensus, with a weaker child giving way to a dominant one without considering an alternative view (Russell, 1982b). Indeed, it is because of problems with compliance and pseudoconsensus that Piaget believed adults to be less effective catalysts of change than peers. Third, the child must be faced with a view that not only conflicts with his own but is also one that he can take seriously. Serious opposition is consistent, reasonable, and backed by data and warrants. It forces the child to question his own position, to recognize the opposition as a "valid centration," and to compare it with his own. Sometimes, before it will be taken seriously, two out of three members of a

triad must press the opposing view, one against one is not enough.

Change does not occur when pseudoconsensus or juxtaposed centrations are tolerated (Russell, 1982b). For example, in a typical conservation of length task, two identical sticks are placed parallel with their ends aligned. The children judge that they are equal. One stick is then displaced, and the children are again asked if they are of the same length. Two children may disagree, one claiming that they are still the same length, the other that now one is longer. Pseudoconsensus that would resolve this disagreement could take the following form, "When you are looking at it, it is bigger, but when I'm looking, they are just the same." Similarly, the children might agree that one stick is now longer but not which one it is--no problem--"from where you are looking, that stick looks very big, but from where I'm standing, it's not so big." These tendencies toward conciliation and pseudoagreement are exacerbated by defensive attributional styles, wherein a child attributes differences to her own ineptitude or to her partner's supposed exper ise.

Although conflict may be an essential trigger, change is mediated through a process of co-elaboration and co-construction (Bryant, 1982; Russell, 1982a, 1982b). Confrontation provides a vantage point from which the children come to challenge both points of view. Together they elaborate, modify, and

restructure, thereby producing a new theory that takes into account their individual differences.

The importance of co-construction is not limited to Piagetian tasks, but has been documented on games such as Mastermind (Glachan, 1982; Glachan & Light, 1982). Because these tasks result in a great deal of spontaneous argument, systematic examination of relations between discourse form and the type of posttest improvement has been made possible. It is this fine-grained analyses of what happens in group discussions, and what type of learning occurs, that is needed now.

In summary, change is not the automatic outcome of group problem-solving. It is not the result of social qua social, motivational qua motivational, or even conflict qua conflict, it is the result of certain social settings that force the processes of decentration and co-elaboration. Groups, peers, and adults can cause change if they set into motion the appropriate processes. By extension, experienced learners can cause change on their own by adopting these process roles in thought experiments, or by "internalizing" experiences of social conflict into intrapersonal dialogues.

Internalization

Both the social support and conflict roles of cooperative learning settings can be gradually removed from the social plane as they are individualized, internalized, or adopted as independent cognition. Indeed, both Piaget and Vygotsky

visualized a form of internal dialogue where the mature thinker plays all the roles, the function of such inner dialogues being that of planning, guiding, and monitoring thought and action.

> The greatest change in children's capacity to use language as a problem solving tool takes place somewhat later in development, when socialized speech (which has previously been used to address an adult) is turned inward. Instead of appealing to the adult, children appeal to themselves; language thus takes on an intrapersonal function in addition to its interpersonal use. (Vygotsky, 1978, p. 27)

> The adult, even in his most personal and private occupation, even when he is engaged on an inquiry which is incomprehensible to his fellow-beings, thinks socially, has continually in his mind's eye his collaborators or opponents, actual or eventual, at any rate members of his own profession to whom sooner or later he will announce the result of his labours. This mental picture pursues him throughout his task. The task itself is henceforth socialized at almost every stage of development . . . the need for checking and demonstrating calls into being an inner speech addressed throughout to a hypothetical opponent whom the imagination often pictures as one of flesh and

> blood. When, therefore, the adult is brought face to face with his fellow beings, what he announces to them is something already socially elaborated and therefore roughly adapted to his audience.
>
> (Piaget, 1926, p. 59)

## Expert Scaffolding

In many social settings all members of the group are not equal, there is one who is quite definitely a first among equals, one with an explicit instructional role. This is sometimes a parent or a mastercraftsman, but in most formal instructional settings, it is a teacher. The expert's job is to scaffold the learning efforts of the novice, providing support for their inchoate learning until that support is no longer needed. The notion of expert scaffolding, most commonly associated with Wood and Bruner (Bruner, 1978; Wood, Bruner, & Ross, 1976; Wood, 1980; Wood & Middleton, 1975), has been extended to cover a variety of informal and formal educational settings (Cazden, 1979; Greenfield, 1984; Scollon, 1976). The metaphor of a scaffold captures the idea of an adjustable and temporary support that can be removed when no longer necessary (Palincsar, in press; Palincsar & Brown, in press).

Procedural supports. Consider a stage intermediate between pure external co-construction of problem solutions and pure intrapersonal thought, a stage where temporary assistance is given to the child in the form of an "assisted monologue"

(Scardamalia, Bereiter, & Steinbach, 1984). In their work on promoting mature written composition, Scardamalia et al. (1984) provided procedural supports in the form of planning and reflection cue cards. These cards contained helpful phrases such as, "An even better idea," "An important point I haven't considered yet is," "This isn't very convincing because," "If I want to start with my strongest idea, I'll," "My main point is," etc. The use of such cue cards, by stimulating self-questioning, produces more thoughtful essays (Scardamalia, Bereiter, & Steinbach, 1984). Provision of similar cue cards proved invaluable in keeping the social and physical science discussions of Barnes and Todd's thirteen-year-olds on track; without them the students' discussions would frequently peter out or go alarmingly off topic (Barnes & Todd, 1977). In another example, fifth and sixth graders, when writing opinion essays, deal with conflict in the form of opposing arguments not unlike younger children do in Piagetian tasks, they juxtapose them with no attempt at resolution, or reject one side completely (Scardamalia, 1981). This tendency is reduced when students are introduced to the notion of a dialectic synthesis of conflicting ideas via the use of cue cards, modelling, and direct instruction (Scardamalia et al., 1984). The provision of cue cards is a form of temporary scaffolding. The prompts are provided to aid reflective thought, and these props are orchestrated by an expert with a clear instructional goal in mind. Such mental prosthetic

devices are a form of expert scaffolding, an attempt to replace the adult role with thinking reminders (the cards).

Real life experts have the advantage over prompt cards in that they can interject the right type of prompt at just the right moment. Wood argues that adult tutorial interventions are inversely related to the child's level of competence--so, for example, the more difficulty a particular child has, the more directive the intervention of the adult should be (Wood, 1980). Similarly, Greenfield (1984) sets out the common structure of scaffolded instruction in two quite disparate informal guided learning settings, language acquisition and learning to weave. The structure consists of six elements: (a) the degree of aid, or scaffolding, is adapted to the learner's current state; (b) the amount of scaffolding decreases as the skill of the learner increases; (c) for a learner at any one skill level, greater assistance is given if task difficulty increases, and vice versa; (d) scaffolding is integrated with shaping, i.e., local correction and aid are given in response to the child's current performance; (e) the aid or scaffolding is eventually internalized, permitting independent skilled performance; and finally (f) in both the language and weaving contexts, the teacher appears to be generally unaware of her teaching function. In formal instructional settings, experienced teachers are also able to scaffold a novice's learning with or without conscious intent to do so. What is intentional is the <u>instructional goal</u>.

Socratic dialogues. The classic example of deliberate, expert-led instruction is that of discovery teaching (Davis, 1966) or Socratic dialogues (Anderson & Faust, 1974; Collins & Stevens, 1982). A thorough analysis and review of the instructional ploys used by Socratic teachers has been provided by Collins and Stevens (1982) and will not be repeated here. Central to these methods, however, is the tripartite goal of teaching: (a) the facts and concepts; (b) a rule or theory to account for these concepts; and (c) how to derive rules or theories in general. Socractic teachers achieve this end by a variety of standard questioning activities that force students to elaborate, justify, and provide warrants and backings for their statements.

Teachers routinely use five main discussion ploys: (a) Systematic variation of cases, where the teacher chooses examples that will help students focus on relevant facts; (b) Counterexamples and hypothetical cases are suggested to question the legitimacy of students' conclusions that, for example, all tap water comes from the river Arno (see earlier); (c) Entrapment strategies are used to lure students into making incorrect predictions or premature formulations of general rules based on faulty reasoning; (d) Hypothesis identification strategies which force students to specify their working hypotheses; and (e) Hypothesis evaluation strategies which make them evaluate prediction rules and hypotheses critically.

Throughout the discussions, which often seem free-ranging, even rambling, the teacher has a consistent agenda of goals and subgoals; higher order goals aim at eventual understanding, opportunistic lower level goals provide temporary scaffolding in order to diagnose and correct local misconceptions. Teachers have consistent priorities for organizing their goal hierarchies, tending to take up errors before omissions, easy misconceptions before fundamentally wrong thinking, prior steps in theory before later steps, important factors before less important ones, etc. In group settings, teacners tend to address students who have not participated recently before those who are more engaged. There is also order in the teacher's method for selecting teaching examples and analogies--ones that exemplify important factors and cases are stressed and grouped together so that significant generalizations can be reached. Finally the teacher fields questions based on her model of the students' knowledge, skipping topics assumed to be known (too simple) or beyond their existing competence (too advanced), and concentrating on what students can assimilate now. Given the continual growth in knowledge, such models of student understanding must be constantly adjusted.

The advantages claimed for Socratic methods are that they model modes of scientific thought, thereby teaching students how to think rather than merely conveying a particular set of content material. Furthermore, Socratic teachers can interact with individual students within their own level of (mis)understanding.

Such teachers are able to gauge how well each student has learned the material by probing for generalized and novel applications of the principles involved. Claims of increased student engagement and motivation are also common.

On the negative side, discovery methods are associated with low information transfer rate, extensive discussion takes place on a limited set of material. And perhaps for this reason, it has been suggested that the method is no more, perhaps even less, effective than lectures (Anderson & Faust, 1974). This is true if tests of effectiveness cover only content retention. Yet to be proven is that there are general improvements in thinking skills, an important item on the agenda for future research.

Internalization. The efficacy of methods such as procedural supports, inquiry teaching, and Socratic discussions depends critically on the key concept of internalization. Children cannot use the prompt cards forever; the hope is that such aid will become redundant over time as the writers or discussants come to perform these reminding activities for themselves. Similarly, the hope is that Socratic methods will be internalized in such a way that individuals can self-test, self-question, and eventually provide entrapment arguments for their own hypotheses and generalizations. These activities of "knowledge worrying" would then become part of an individual's own hypothesis testing mental activities, feeding directly into the young child's propensity to experiment with procedures, more and more

sophisticated and systematic ways of doing so. In short, the mature learner is capable of autocriticism, which Binet singled out as the hallmark of intelligence (Binet, 1909; Brown, 1985) and Piaget (1976b), in the notion of reflective abstraction, regarded as the central pillar of formal thought.

## Reciprocal Teaching of Comprehension Strategies

### Theoretical Rationale

In this section of the paper we will focus on our own work on cooperative learning and expert scaffolding embodied in a procedure known as reciprocal teaching. (See Brown & Palincsar, 1982, in press; Palincsar & Brown, 1984, 1985 for details.) Reciprocal teaching was designed to provide a simple introduction to group discussion techniques aimed at understanding and remembering text content. Expert scaffolding was provided by a teacher who attempted to modulate the children's discussion. We believed that if we could establish a very simple routine that could be handled by average teachers and less than average students, then it would be possible at some future date to build upon the simple routine and provide practice in more complicated argument structures of premise, justifications, warrants, and backings.

Reciprocal teaching takes place in a cooperative learning group that features guided practice in applying simple concrete strategies to the task of text comprehension. The basic procedure is simple. An adult teacher and a group of students

take turns leading a discussion on the contents of a section of text they are jointly attempting to understand. The discussions are free-ranging but are constrained by the requirement that the discussion leader ensure that four strategic activities are practiced routinely: questioning, clarifying, summarizing, and predicting. The dialogue leader begins the discussion by asking a question on the main content and ends by summarizing the gist. If there is disagreement, the group rereads and discusses potential candidates for question and summary statements until they reach consensus. Summarizing provides a means by which the group can monitor its progress, noting points of agreement and disagreement. Particularly valuable is the fact that summarizing at the end of a period of discussion helps students establish where they are in preparation for tackling a new segment of text. Attempts to clarify any comprehension problems that might arise. Are also an integral part of the discussions. And finally, the leader asks for predictions about future content. Throughout, the adult teacher provides guidance and feedback tailored to the needs of the current discussion leader and her respondents.

The procedure was designed to embody both expert scaffolding and cooperative learning features. The group is jointly responsible for understanding and evaluating the text message. All members of the group, in turn, serve as learning leaders, responsible for orchestrating the dialogue, and learning listeners (Yager, Johnson, & Johnson, 1985) or supportive critics

(Binet, 1909; Brown, 1985), whose job it is to encourage the discussion leader to explain the content and help resolve misunderstandings. The goal is joint construction of meaning; the strategies provide concrete heuristics for getting the procedure going; teacher modelling provides examples of expert performance; and the reciprocal nature of the procedure forces student engagement.

Strategies. The deceptively simple reciprocal teaching procedure is based on several instructional principles involving the strategies taught, the environment in which they are taught, and the role of the instructor in guiding learning. First consider the strategies: questioning, clarifying, summarizing, and predicting were not randomly chosen activities. They are examples of strategic activities that good students routinely bring to the task of studying texts, but poor students rarely report using, either during on-line attempts to study or in retrospective reports (Brown & Lawton, work in progress). Furthermore, they serve an interesting dual function if used intelligently; they both improve comprehension and afford the alert reader an opportunity for monitoring understanding. For example, if one attempts to paraphrase a section of text and fails, this is a sure sign that comprehension and retention of main points is not proceeding smoothly and that some remedial action, such as rereading, is called for. The strategies are self-testing mechanisms and there is ample evidence that such

self-testing improves comprehension (Brown, Armbruster, & Baker, in press).

In reciprocal teaching, the strategies are practiced in an appropriate context, during ongoing studying, not as isolated separate skill exercises to be mastered individually and then used whenever the students see fit. Each separate strategy is called into play in response to a concrete problem of text comprehension. For example, the students learned that summarizing was a test to see if they understood what had happened in the text. If they could not summarize a section, this fact was regarded as an important source of information that comprehension was not proceeding as it should, not as a failure to perform a particular skill. Similarly, clarifying occurred only if misunderstandings were generated by some unclear aspect of the text or by the student's interpretation of the content. The strategies were introduced as tools to provide a backbone to the discussion and to achieve the acknowledged goal of understanding and remembering. The main goal was not refining the strategies but understanding the text; of course, improvement in strategy use was a much-welcomed side benefit.

The discussions focussed on both the text content and the student's understanding of the strategies they are practicing. For example, discussion of the aptness of a particular summary statement in capturing the essential gist, teaches students about

the strategies as well as helps them to understand the particular content of any one text.

Another interesting feature about these particular strategic activities is that they can serve to scaffold intrapersonal as well as social dialogues. Reviewing (summarizing) content, attempting to resolve misunderstandings (clarifying), predicting possible future text development, and questioning the state of one's gradually accumulating knowledge, are all activities that the experienced learner engages in while studying independently, by means of an internal dialogue. The reciprocal teaching procedure renders such internal attempts at understanding external. Reciprocal teaching provides social support during the inchoate stages of the development of internal dialogues. In the course of repeated practice such meaning extending activities, first practiced socially, are gradually adopted as part of the learner's personal repertoire of learning strategies (Vygotsky, 1978).

Finally, these particular strategies are readily taught, at least to the extent that the novice can begin participating early. Closing one's eyes (metaphorically) and retelling what one has just read is the first step towards more and more sophisticated attempts to state the gist in as few words as possible. Similarly, asking about the meaning of any unknown word is a clarification exercise that lays the ground for more subtle comprehension-monitoring of unknown or unclear ideas or

referents. Practically, it is very important that the students can handle an easy version of the strategies quickly, thus providing them with entree into the discussions. Refinement in strategy use, however, is gradual, and takes considerable practice.

The learning environment. Reciprocal teaching was designed to be a form of proleptic teaching, proleptic meaning "in anticipation of competence," where the mature task is maintained even if each individual member of the group is not yet capable of full participation (Wertsch & Stone, 1979). Proleptic teaching is best illustrated by comparison to what it is not. Consider tried and true educational concepts such as easy-to-hard sequences and fading. In such procedures, the novice learner is introduced to a "skill" by starting out on an easy version of the target task. Upon success, often after errorless learning on the easy task, a more difficult version is "faded in," and this step is repeated through gradually incrementing levels of difficulty until the learner is confronted with the "mature" version of the target task. The problem is that the easy versions are often pale shadows of what the real task will be; indeed, the early forms are often unrecognizable as facsimiles of the target task. For example, one way of making the task easier is to divide it into manageable subcomponents and to provide practice on these in isolation until they are perfected. This increases the likelihood that the easy tasks will not resemble the complex

target, and it is often the case in educational settings that the role of recombining the subcomponents (vertical transfer) or using them flexibly in tasks of which they are elements (lateral transfer) is left up to the student (Gagne, 1965).

In proleptic teaching, in contrast, the integrity of the target task is maintained; components are handled in the context of the entire task; skills are practiced in context. In proleptic teaching, the task remains as undisturbed as possible, the novice's role is made easier by the provision of procedural supports, expert scaffolding, or a supportive social context that does a great deal of the cognitive work until the novice can take over more and more of the responsibility. The task, though, remains the same, the goal the same, the desired outcome the same. There is little room for confusion about the point of the activity, thus finessing to some extent both metacognitive ("what am I doing") and transfer ("what should I do here") problems (Brown, 1978; Brown & Campione, 1984).

The cooperative feature of the learning group in reciprocal teaching, where everyone is trying to arrive at concensus concerning meaning, relevance, and importance, is an ideal setting in which novices might practice their emergent skills. All of the responsibility for comprehending does not lie on their shoulders, only part of the work is theirs and even if they fail when called upon to be discussion leaders, the others, including the adult teacher, are there to keep the discussion going. The

group shares out the responsiblity for thinking and thus reduces the anxiety associated with keeping the argument going singlehandedly (Pontecorvo, 1985). Because the group's efforts are externalized in the form of a discussion, novices can contribute what they are able and learn from the contributions of those more expert than they.

The role of the instructor. The adult teacher in reciprocal teaching plays many roles. First, she provides a model of expert behavior. When it is her turn to be the teacher, and when she is shaping the teacher role-playing of the students, she is able to model mature comprehension activities, thus making them overt, explicit and concrete. Comprehension-fostering and monitoring activities are difficult to observe as expert learners usually execute them covertly. In reciprocal teaching the teacher can engage in the strategies overtly, and hence provide a model of what it is that experts do when they try to understand and remember texts. This repetitive modeling serves to demonstrate to the students concrete ways of monitoring their own learning through methods they can readily understand. Instead of being told to "be strategic" and "monitor your comprehension," the students see that the teacher does this by retelling content in her own words, by asking what something means, and by posing questions about main points. This they can emulate.

Second, the teacher has a clear instructional goal. In many forms of cooperative learning, the students are left to construct

learning goals for themselves; the goals change over time as the interests of the group changes (Griffen & Cole, 1984), and groups sometimes concoct goals far different from those envisaged by the authorities (Barnes & Todd, 1977). In reciprocal teaching, membership in the group is not democratic; the adult teacher is definitely a first among equals. Her goal is clearly one of keeping the discussion focused on the content and directing the group's efforts towards cognitive economy, i.e., enough discussion should take place to ensure a reasonable level of understanding but no more.

Third, the adult teacher closely monitors the learning leaders giving them room to control the discussions when they can. But she is always ready to provide feedback and, if necessary, to take back the leader role when things go awry. The adult teacher provides feedback that is tailored to the student's existing levels, encouraging them to progress gradually toward full competence. Note that students must participate when it is their turn to be the teacher, or when they answer the questions of the learning leaders, even if they are not yet expert. Because the students do participate, the teacher has an opportunity to gauge their competence, competence that is often masked in other settings by weaker students' tendency not to volunteer until they are sure of themselves, which may be never.

Embodied in the philosophy of reciprocal teaching is a kind of planned obsolescence; the teacher watches for the opportunity

to make herself redundant. The idea is to take control only when needed and to hand over the responsibility to the students whenever they are ready. The responsibility for the comprehension activities is transferred to the students as soon as they can take charge of their own learning. Through interactions with the supportive teacher, the students are guided to perform at an increasingly more mature challenging level. In response, the adult teacher gradually fades into the background and acts as a sympathetic coach leaving the students to handle their own learning. Like a coach, the teacher is always monitoring the discussions and is ready to step back and relinquish control or step forward to take up the reigns again when necessary. Of course, reciprocal teaching was consciously modelled after naturally occurring expert scaffolding procedures.

## Main Findings: The Reading Setting

The original development of the reciprocal teaching procedures took place in the context of reading groups consisting of seventh and eighth graders. Subsequently, however, we have adapted the procedures for use with much younger children (grades 1-2) in a listening comprehension setting. We will give some of the key results from the reading program before turning to the new work with listening comprehension.

Several features are common to many of the studies we have conducted with reading comprehension: (a) the students were selected from junior high schools on the basis of their low

scores on reading comprehension tests; (b) the intervention was fairly extensive (by experimental standards) consisting of never less than ten days of discussions and usually continuing for four weeks, or approximately 20 days; (c) progress was measured not only by observable changes in the students' participation in the discussions, but also on daily independent tests of their reading and retention of novel passages. This is a conservative test of progress; most studies of group learning estimate individual retention of the discussed material only, not the application of the learned processes to novel materials; (d) long-term maintenance, transfer and generalization were all measured along with improvements in standardized test scores.

Participation in the discussion. Independent raters were quite able to rate the sophistication of the discussions by correctly assigning the transcripts to the first, second, and third half of the intervention. Individual students' scores on the four strategies of summarization, question formulation, clarification, and prediction all showed large and reliable improvement (Brown & Palinscar, 1982; Palinscar & Brown, 1984). But these numerical facts do not begin to illustrate what actually happened to the students' participation--they progress from relatively passive answerers of others' questions to quite adequate discussion leaders. Only by looking at the dialogues, however, can one really grasp the extent of these changes.

As an example, let us consider a volunteer teacher interacting with a group of seventh grade remedial readers. Excerpts from their discussions are shown in Tables 1 and 2. The dialogues are from early (Day 3) and later sessions (Day 13) with the same group of five students. In the early sessions, the adult teacher is very much the learning leader, even though a student (A) has been assigned that responsibility. In this example (Table 1), one segment of silent reading is followed by an extensive discussion, where the students interact with one another only once (statements 1-3); the remaining interactions follow a typical teacher-directed classroom format, teacher followed by student, teacher followed by student.

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Insert Tables 1 and 2 about here

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The same group is seen again, ten instructional days later, in the dialogue shown in Table 2. Here three reading-discussion sets are included in 29 statements, rather than only one as on Day 3. And now the majority of the interactions are student-controlled, with the teacher interspersing praise, encouragement (4, 10, 12), and management (4, 14, 21). The teacher intercedes with advice and modeling only when a student misses the point and the others do not catch it (statements 18, 26, 28). The teacher has moved from the pivotal role of responding individually to each student, to that of a coach who sits in the background,

offers encouragement, and occasionally pushes for a better interpretation of the text. The teacher provides just the degree of scaffolding necessary for the discussion to remain on track, leaving the students to take over as much responsibility as they can.

Independent learning. The changes that were seen in the discussions were reflected in the students' independent studying behavior. Collapsing across several replications of the intervention, we have found that students in general begin by scoring 30-40% correct and reach a stable level of 70-80% correct within four to fifteen days. When the teachers were seasoned volunteers, 98% of the students reached criterion (Palincsar & Brown, 1984).

Reciprocal teaching is instructionally viable. In studies conducted by non-volunteer, unselected teachers the success rate was not quite so dramatic but still impressive, if we consider that the instructional period is only four weeks. For example, the results shown in Figure 1 come from six teachers who were assigned to the program under conditions that were not exactly ideal, for 150 students were also assigned to the study, with the group size ranging from eight to eighteen! And the teachers varied in their enthusiasm, experience, and teaching skill, which ranged from barely adequate to outstanding. The teachers taught one reciprocal teaching group and another group in their regular fashion, thus serving as their own control--sometimes---two of

the better teachers gradually introduced more and more of the reciprocal teaching features into their control classes which also began to improve, a desired outcome for the students but not for the experimenters. On the top half of Figure 1, averaged data reveal the significant improvement of the reciprocal teaching group compared with the control classes. On the bottom half of Figure 1 are shown the number of students reaching criterion or maintaining better than a twenty percentage point gain. Reciprocal teaching procedures result in significant individual student achievement even under less than ideal circumstances (Palincsar & Brown, in press; Palincsar, Brown, & Samsel, work in progress).

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Insert Figure 1 about here

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The reciprocal teaching procedure can be modified so that the essential features can be used in whole class discussion. For example, seventh grade teachers have introduced the discussion techniques into their science classes where the number of students make the strict oral turn-taking of reciprocal teaching unwieldy. In its place they substituted a procedure whereby the students and teacher read approximately four paragraphs silently during which time they individually composed two questions and a summary statement in preparation for group discussions. After several segments had been covered, the

teacher asked students to volunteer their responses and wrote several candidate summaries and questions on the board. Then the students as a group debated the merits of each until they reached a degree of consensus on the most appropriate version. Requests for clarifications were also handled at this point. Over the semester the students showed marked improvement on their written questions and summaries and on their classroom participation; in addition, they improved significantly on daily independent tests of comprehension (Palincsar, Brown, & Samsel, work in progress).

Finally, while on the subject of who can conduct reciprocal teaching, we have had some success in training peer tutors. We asked three adult teachers, experienced with reciprocal teaching, to supervise nine tutors, selected because, even though they were remedial readers, they scored well on our baseline assessments (70% correct). The teachers trained the tutors in the reciprocal teaching procedure and then assigned them one or more tutees who were performing poorly (40% or below) on baseline measures. The teachers supervised the initial tutoring sessions, giving aid and answering questions when needed. By the second half of the intervention, the tutors were able to bring the independent scores of their tutees up to 78% correct, and in so doing reached a level of 87% correct themselves.

Reciprocal teaching is more than the sum of its parts. These reliable improvements in reading comprehension scores are not easily come by with the poor learning students who are our

main clients. For example, to further test the effectiveness of the reciprocal teaching procedure, we have conducted a series of comparison studies where the method is pitted against a variety of control groups. We will give just two examples here. In the original set of studies (Brown & Palincsar, 1982; Palincsar & Brown, 1984), we included obvious control conditions where, for example, students took all the daily tests but received no training. We also included a group of students who took the daily tests and had an equal number of instructional days devoted to a procedure, locating information, where the teacher guided the students in finding the answer to the questions in the text. These results are shown in Figure 2. Only the reciprocal teaching group showed reliable improvement, reaching the level set by average junior high school students.

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Insert Figure 2 about here

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One could legitimately argue that the locating information training, although providing extensive practice in test taking, did not provide appropriate strategy training. Taken together, the results from the control groups rule out explanations of the reciprocal teaching students' improvement in terms of practice, teacher attention, time on task, etc., but they do not separate out the strategy training from the reciprocal teaching element. There is a great deal of research now that suggests that explicit

instruction in strategy use is necessary before any significant improvement in students' independent performance will be seen (Brown, Bransford, Ferrara, & Campione, 1983; Brown, Campione, & Day, 1981). Hence, it is not the most stringent test of the reciprocal teaching procedure to compare it to practice conditions only or to an intervention that does not include appropriate strategy training. Therefore, we contrasted reciprocal teaching to other interventions that included training in the identical strategies of questioning, clarifying, summarizing, and predicting.

The results of one illustrative study are shown in Figure 3. Groups of closely matched junior high school students, all with reading comprehension problems, were assigned to one of three training conditions or to a control group. Students in each of the training conditions received twelve sessions involving group instruction and independent daily tests. The three instructional groups were reciprocal teaching (RT), modeling (M), and explicit instruction (EI). In the modeling group, the teacher modeled how to use the four strategies on each segment of the passages and the student's role was to observe and answer the teacher-posed questions. In the explicit instruction group, the teacher demonstrated and discussed each strategy for the first half of the session; and in the second half, the students completed pencil and paper exercises in applying the strategies to the remaining text segments. Thus, modeling consisted of an expert

talk-aloud procedure in which the teacher herself used the strategies for the students to see (Bereiter & Bird, 1985). Explicit instruction was based on normal classroom demonstration and practice routines. In both cases, however, the explicit teaching in the modeling and demonstration procedures was focused on the strategies themselves, not a common classroom practice (Durkin, 1984).

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Insert Figure 3 about here

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As can be seen in Figure 3, all groups improved except the untreated control; however, this improvement was not statistically significant in the case of the modeling group. Furthermore, the reciprocal teaching students' performance was significantly better than that of the explicit instruction group. Explicit instruction and actual experience applying the strategies is a better procedure than teacher modeling, a procedure in which the students received no independent practice. Far better, however, is the reciprocal teaching method where the students receive instruction, modeling, and practice, gradually taking charge of their own learning (Brown, Palincsar, Samsel, & Dunn, work in progress). Not all methods of training comprehension strategies are equal.

Generalization of the effect. We would like to emphasize that these improvements in individual learning scores were

maintained over time, for up to six months in the one study where we were able to test after such a delay (Brown & Palincsar, 1982), and always after a two month delay, the time span of our routine maintenance check (Palincsar & Brown, 1984).

Perhaps a more dramatic indication of the effects of reciprocal teaching instruction is the extent to which the students improved in settings other than those orchestrated by our project personnel. In general we have found three types of transfer of training: (a) generalizations to the classroom, (b) improved performance on posttests that tap the trained skills, and (c) improvement in standardized scores. Representative transfer data, taken from the original Palincsar & Brown (1984) studies, are shown in Figure 4. Entries 1 and 2 represent

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Insert Figure 4 about here

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data taken from classroom generalization probes. Following a traditional practice in the cognitive behavior modification literature (Meichenbaum, 1977), tests identical to our daily independent learning assessments were administered in the classroom setting. The students read science and social studies content passage in these classes and answered comprehension questions on them from memory. No mention was made of the fact that these tasks formed part of the study; and to maintain the cover, all seventh graders ($\underline{N}$ = 130) took the tests as part of

their regular classroom activity. In the top part of Figure 4, the performance over time of the reciprocal teaching group is compared with that of matched control students. The reciprocal teaching group showed steady improvement while the control students did not. Perhaps of more interest are the data shown in the second part of Figure 4; this is the reciprocal teaching students improvement in percentile rankings compared with all of the seventh graders in the school (students drawn from the full range of ability). Whereas the control group showed only random fluctuations in their rankings, the reciprocal teaching students improved dramatically, bringing the level to above the average for their age.

The third set of statistics shown in Figure 4 are the reciprocal teaching students improvements on standardized tests of reading comprehension. Again, the improvement was dramatic; one third of the students testing at or above grade level. Similar findings were found when non-selected teachers conducted the program, with students in reading groups improving eleven months and those in the science classes 15 months after a few weeks of instruction.

Finally, reciprocal teaching students, but not control subjects, showed significant improvement on laboratory tests that differed in appearance from the training tasks, but could be said to tap the same underlying processes. The level of improvement was sufficient to bring them up to that set by average junior

high students. Reciprocal teaching students showed reliable improvement in their ability to apply macrorules to the task of writing summaries of texts (Brown & Day, 1983), in their ability to contruct appropriate comprehension questions to accompany a text, and in their ability to detect (clarify) anomalous sentences in texts (Harris, Kruithof, Terwogt, & Visser, 1981).

Main Findings: The Listening Setting

Over the past three years we have been working on an adaptation of the reciprocal teaching procedure so that it can be used with younger and more severely impaired learners, those whose lack of decoding skill compounds their comprehension difficulties. A primary reason for developing a procedure that can be used as soon as the child enters school is the importance of early detection in designing remedial education. It is entirely possible that the child with problems of listening in first grade will become the student with reading comprehension difficulties and inadequate study skills in the later grades. Psychometric studies clearly indicate that by third grade and beyond, listening comprehension scores are excellent predictors of reading and general academic success (Curtis, 1980; Humphreys & Parsons, 1979). Before this period, however, listening comprehension scores do not predict reading well; the better predictor is decoding speed and accuracy (Curtis, 1980). However, there is a problem with interpreting this age effect. Before grade three, standardized tests of reading competence are

heavily biased toward the measurement of decoding and, therefore, it is not surprising that independent tests of decoding predict reading scores, which are themselves primarily tests of decoding.

Tests of listening comprehension designed for use in the early grades often measure something other than comprehension, notably rote memory. As the tests are discontinuous across age, it is less likely that performance at the earlier age would predict later success. By extending the reciprocal teaching procedure to a younger age range, we will be able to train and test the identical strategies and procedures in both listening and reading and, therefore, we should have a better basis for early detection of general comprehension problems. If we can diagnose a problem early in a child's academic career using a listening task, this information might (a) help us to predict who will have subsequent reading comprehension difficuties, and (b) enable us to provide training before the child experiences extensive failure, with all the attendant problems such failure portends (Brown, Palincsar, & Purcell, 1985; Dweck, 1985).

Our work with listening comprehension followed the same route as that with reading. We began by developing, refining and establishing the details of the procedure in a laboratory setting where the teaching was undertaken by experts. Only then did we test the procedures in the regular classroom, recruiting average teachers to see if we could obtain reasonable results under the normal pressures of the classroom. For brevity we will discuss

only the classroom studies here. (See Brown & Palincsar, in press, for details of the laboratory studies.)

In a representative classroom study, eight first grade teachers were assigned to the project. Each teacher received three days of in-service training and then interacted with groups consisting of six first graders. Each group of six consisted of four high-risk children diagnosed as in need of individual educational programs (IEPs) and awaiting more permanent special education placement testing. The remaining two children were the stars! The non-volunteer teachers were more than dubious that the weaker students could participate in the discussions and, as a safeguard against total disaster, wanted to include others whom they felt could handle the procedure. These children supposedly had no learning problems; however, in this particular district all the children, including the stars, fell at or below the median on standardized scores.

Participation in the discussion. Let us look first at one group in detail. The group consisted of (pseudonyms) Mara and Charlie, the stars, and Daryl, Susan, Reggie and Justin, the high-risk children. Actually, only Daryl and Susan were very low scorers. Charlie scored well above average and the other three children were of average ability. The examples we have selected primarily feature Daryl, a slow learner with both speech and hearing problems that caused some concern about his ability to participate in the group. Daryl had a full scale IQ of 82, and

his individual listening scores before instruction averaged 44%. During training, he showed steady improvement, scoring 60% during the first half and 80% during the second half of the intervention.

Daryl failed to contribute spontaneously for the first six days, and the teacher called on him rarely. Daryl, among other problems, stuttered, and when he did begin to contribute, the teacher tended to come to his aid too quickly in an attempt to avoid embarrassment. By the last few days, however, Daryl had improved dramatically.

Let us pick up the group on Day 18; they are half way through a long passage about Daddy Long Legs. In Table 3, we see two teacher statements, only one of which (20) is a clarification of a major misunderstanding. Daryl, without help, comes up with an excellent question, albeit clumsily phrased, leads the discussion, and composes a reasonable summary. He is in total charge of the dialogue until statement 11, when Mara asks for clarification of the ambiguous it that is giving out bad smells. Daryl knows the answer (21), but can't quite deal with the confusion, so the teacher must clear it up for him (20). The teacher only comes in when needed; she leaves the children to settle the dispute if they can.

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Insert Table 3 about here

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In Table 4, we begin with an interruption for a vocabulary clarification and then there is a long segment on the features of Daddy Long Legs that are not spider-like. Note that Daryl offers a question (9) even though it is not his turn because he, later echoed by Charlie, is confused by how a Daddy Long Legs catches its food if it doesn't bite. In order to do this, Daryl must have been monitoring both the content read by the teacher and the ensuing dialogue. Again the teacher intervenes to clear this confusion (23). Even though 20 utterances have intruded following her original question, Susan still remembers her responsibility as teacher and summarizes (24, 26, 31) with some help from the teacher (27).

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Insert Table 4 about here

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In Table 5, Daryl again asks a question (10) when it is not his responsibility, and it is a better question than Susan's original request for detail (1). He goes on to evaluate Justin's answer (13). Daryl must be listening to the text, remembering its content, and monitoring the dialogue in order to be able to make these contributions. Susan remembers to summarize (17, 19) with help from the teacher, even though other questioners, notably the intrusive Daryl, have interrupted her role as teacher. The teacher's turns are mainly management,

reinforcement, feedback, and attempts to bring in any non-participating children, in this case Charlie.

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Insert Table 5 about here

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Daryl is legitimately the teacher, responsible for questions and summaries, in the excerpt shown in Table 6. He formulates a question (1), but it is one that Mara rejects (2); so he tries again (3), hitting on one detail from a passage of many details. Daryl is then interrupted by a long clarification sequence about how Daddy Long Legs can stand on water, and is himself interrupted by other questioners. Thirty utterances later, Daryl, without reminding, summarizes quite adequately (32), especially since this segment is one from which it is quite difficult to extract a single main idea. Note that we are not claiming that Daryl's summary is perfect, far from it; the teacher continues this segment by shaping up Daryl's ideas. What we are claiming is that Daryl has gone from a non-contributer in the early sessions to a fully participating member of the group--able to do his best as learning leader (with considerable help from the teacher), contributing questions, and clarification requests, evaluating the answers he receives, and remembering his responsibility to summarize the text and dialogue, even after considerable interruption. The same could be said for Susan, the other very low scorer in the group.

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Insert Table 6 about here

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In constrast we will consider Mara, clearly the teacher's favorite, one nominated by her to be a star. Actually, Mara's independent performance is little different from Daryl's, but because of the teacher's expectations of her ability, Mara is called upon often in the early sessions. By the latter sessions, she is very much in evidence as a teacher's helper.

In Table 7, the discussion centers around the notion of camouflage and the meaning of the word "dull." Reggie, a quiet child, is the learning leader. The teacher is very much in evidence, however, in leading the discussion as Reggie cannot yet handle the responsibility alone. Of interest here is Mara's role after the first part of the dialogue, when the critical issue of the meaning of the word "dull" comes up. Mara alternates with the teacher in keeping the dialogue going. She argues with the teacher that there is no clue to why Daddy Long Legs can't be seen (12), asks for a fix-up strategy, in this case rereading (14), notes the clue word, dull, on rereading (16), and comes up with the first definition (22), "like dark paint," which she never relinquishes, even in the face of Justin's championing of green [(Mara, 22, 27, 30, 27, 47; Dull = Black, Blackish, Dark Paint) (Justin, 24, 28, 32, 34, 46; Dull = Green)]. Pseudoconsensus is reached, but Mara sticks to black or dark, and Justin still

insists on green. Mara alternates with the teacher, and indeed by the last few days of discussions the teacher has some difficulty repressing Mara sufficiently to give other children equal time. Nonetheless, Mara is an excellent role model for this group.

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Insert Table 7 about here

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We would like to point out that although the first graders became quite efficient contributers to the discussions, they did not take over the learning leader role as quickly or as completely as did the junior high school students. Compare, for example, the late (Day 20) first grade dialogues shown in Table 8 with the dialogue (Day 13) from seventh graders shown in Table 2.

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Insert Table 8 about here

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Even though the excerpt in Table 8 forms part of the last day of instruction, the teacher has reverted to the pivotal teacher role. She models vocabulary clarification, one of the simplest and earliest activities mastered. Here she is working on the clarification of regionally inappropriate words, e.g., rain spouts and cellars for gutters and basements, pointing out lost opportunities for clarification requests (36). She is also closely involved with keeping Reggie on the track of his

question, which the constant interruptions make him forget (Teacher 15, 17, 27, 29, 32; Reggie 16, 18, 23, 30, 33). In contrast, in Table 2, the teacher rarely takes over tne dialogue from the seventh graders, and a reflection of this transfer of responsibility is that a great deal of text gets covered by the students in one day. Two-thirds of the segments are covered efficiently with little discussion as in statements 1-4 in Table 2, which consist of a question, an answer, a summary, and teacher praise. The younger children need more teacher-direction for a longer period of time.

One point of concern with all dialogue teaching procedures, and reciprocal teaching is no exception, is the leisurely pace of the reading. Because of the focus of the procedure, discussing content until one understands, very little text gets covered until the students become more skilled in using the strategies. This is seen as a problem by some teachers who have come to regard progress in reading lessons in terms of the number of pages covered each day. However, the relatively slow rate of information exchange can be defended because the main agenda is to teach methods of understanding any text, not just to assist in the acquisition of the content of one particular text. Very important, then, is the additional evidence that students are acquiring facility with the processes of learning.

Independent learning. Shown in Figure 5 are the independent learning scores of the six children who featured in the dialogues

of Tables 3-8. On the right hand side are the averaged data of these children when they were in an untreated control condition (20 days) and subsequently when they received 20 days of instruction. The improvement in the reciprocal teaching condition is steady and reliable. On the left hand side of the figure are the children's individual learning curves. Five of the six reached a criterion of 70%; only one, Susan, did not show a 20% gain. One, Charlie, started and finished well, the remaining children all show the typical gain pattern of our reciprocal teaching studies. Daryl's progress was particularly dramatic.

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Insert Figure 5 about here

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In Figure 6 we have plotted the averaged data for all of the children in the study, 96 reciprocal teaching students (the teachers taught two groups each) and 48 control subjects. Again we can see the reliable gain for reciprocal teaching students and the steady state of the control (practice) condition. On the bottom half, we have plotted the number of children reaching criterion of 70%, maintaining a 20 percentage point gain, performing at ceiling throughout (like Charlie), compared with those showing no reliable gain. Comparing this pattern to that shown in Figure 1 illustrates the difference between the success of the reading and listening interventions. The nonvolunteer

reading teachers who provided the data in Figure 1 helped 71% of the seventh grade students reach criterion and 24% achieve a 20% gain (compared with 98% reaching criterion when expert teachers ran the program). In contrast, only 54% of the listening students could be judged a success. True, 2 of the 8 teachers did not implement the procedure properly, but we believe that the differences reflect the fact that 20 days was not quite long enough for the very young children to fully and consistently take over the learning leader role, an hypothesis we are testing with a more extensive longitudinal intervention. Nonetheless, 30% failure to show reliable independent learning in the reciprocal teaching group compares very favorably with the 71% failure rate in the control condition. The difference between reciprocal teaching and control conditions is large and reliable. It is a stringent benchmark of progress indeed that demands a criterion of performance that, in essence, qualifies the children as independent learners.

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Insert Figure 6 about here

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Generalization of the effect. To buttress the claim of improved independent learning, in Figure 7 we show further evidence of the effectiveness of the reciprocal teaching practice. The data are the pre- and posttest transfer measures on the four target strategies practiced independently out of the reciprocal

teaching context. The reciprocal teaching children show a reliable improvement, while the control groups do not.

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Insert Figure 7 about here

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In addition to the independent comprehension and retention questions centered on the text content, in our more recent studies we have included application questions where the children are asked, at a very simple level, to apply what they have just learned. In other words, these questions test whether the knowledge gained from the text is represented in usable form rather than merely retained inertly for a subsequent test. As texts for the reciprocal teaching sessions, we used sets of analogous materials that differed in surface details but shared underlying principles such as camouflage, biological deterrents, animal survival, etc. For example, a text on the camouflage theme concerned the history of masks and included the information that cavemen used masks of animals when they hunted because they believed that their prey would mistake them for one of their kind. During questioning, the children were given the following problem to solve: Indians hunting deer in the prairies covered themselves in deer hide when they went on hunting parties--why might this be so? Similarly, under the biological deterrent theme the children heard about the Manatees, large sea mammals that were forced to move inland, where they took to eating the

water irises that had previously clogged Florida's inland waterways. In the questioning, the children were asked to solve the following problem: In a certain part of Australia, the parks are being taken over by a weed that kills all the wild flowers. In another part of Australia are Kangaroos that like to eat this weed. How could they solve the problem? In another natural predictor passage, the children read about ladybugs eating harmful bugs that plague orange groves and hop fields--and are then asked how to rid ponds and lakes of green algae.

Before training, children are loath to use their newly acquired knowledge. For example, one child made no reference to the Manatees at all when trying to solve the kangaroo problem. When prompted with the question, "Tell me about the Manatees," he replied, "I can't tell you about them, I've never seen one in my life." Persistent, the adult probed further, "What did they do in Florida to cure the water iris problem?" The child responded, "Gee, I should know that one--I've just come back from Florida." It was as if the information in the text, read, listened to, discussed, etc., made no contact with his own usable knowledge. Other children fared a little better, suggesting that we "send the Manatees to Australia"--showing contact with the prior story at least.

So far we have found that regular practice greatly improves the ability to use analogy to solve the questions; that is, guided practice creates a mind set to reason by analogy.

Children begin by noting few of the analogies but during the later part of the intervention they are able to solve the analogies with a 60% success rate. Repeated experience noting the analogy between a text fact (masks of animals make the animals think the cavemen are fellows) and a problem solution (deer mistake deer-skin covered Indians for deer) could lead to quite different methods of reading and discussing than does practice on questions that examine only content retention. We are currently testing this hypothesis in greater detail.

## Reciprocal Teaching, Argument Structure, and Systematic Knowledge Acquisition

In this final section, we will discuss what we have accomplished with reciprocal teaching and what still remains to be done. As currently practiced, reciprocal teaching is a form of guided, cooperative learning featuring: expert scaffolding by an adult teacher; a supportive environment of learning leaders and listeners; and direct instruction, modelling, and practice in the use of four simple strategies that serve to prop up an emergent dialogue structure.

The strategies featured so far have been very simple activities, serving primarily as checks that the children have understood the main content, and as rather crude devices for getting a discussion going among students who are not accustomed to engaging in sophisticated Socratic dialogues. Questions, for example, initiate each piece of dialogue, giving the teacher some

indication of whether the learning leader has understood and providing a starting point for the learning listeners' discussion. Clarification takes care of obvious points of confusion, with the younger children using the device almost exclusively to resolve problems of pronominal reference and unknown vocabulary. Summarization, or more accurately retelling, takes place at the end of each text and discussion episode, serving as a means by which progress can be monitored, points of agreement and conflict checked, and ideas contributed from many sources combined into one statement. It serves as a form of place-holder, a method of rounding off conversation in preparation for the next interaction with the text (Barnes & Todd, 1977).

But these activities are only primitive precursors of potential argument forms. In future work we intend to build on this simple beginning and examine more elaborate argument devices and epistemic roles. Profitting from information gained from naturally occurring dialogues (Barnes & Todd, 1977; Paley, 1981; Pontecorvo, 1985) and theoretical analyses of argument (Toulmin, 1958) and explanation structures (Von Wright, 1971), we can modify our guided learning instruction in order to introduce students to such notions as premise, supporting/conflicting data, warrants, and backing, albeit in a simple form. Similarly, we intend to examine artificially legislated shared responsibility for problem solving, with children taking on such roles as that of the

executive, skeptic, record keeper, etc., a more complex division of labor than that of learning leader and learning listener. Will these shared experiences enable children to deal with more extensive and substantive texts?

Which brings us to the problem of knowledge and content. So far we have concentrated primarily on children's learning of naturally occurring grade appropriate expository texts of a vaguely scientific nature (for example, see Snakes in Table 1, Salt in Table 2, Daddy Long Legs in Tables 3-8). These materials have several drawbacks if one is interested in the accumulation of knowledge, as well as process. First, they encourage encapsulated knowledge acquisition; topic follows topic with little opportunity for cumulative reference. Second, the material is such that there is little room for emotional engagement, controversy, opinion, conflict, or dispute. Coupled with the choice of material has been another practice modelled on school routine; tests of learning have been primarily measures of fact and simple inference. Such procedures positively encourage the child to build up encapsulated "inert" knowledge, rarely used again after the test hurdle has been surmounted. If one is interested in reading as a process of decoding text and understanding the meaning, any text will do, and any test of encapsulated short-term retention will serve to ascertain whether the child has read and understood. But if one is interested in

learning, in the sense of acquiring a usable, flexible body of knowledge, such procedures are unsatisfactory.

Having established that academically marginal children can readily handle short-term tests of encapsulated knowledge, an outcome by no means predicted by many colleagues and teachers who deal with similar populations, we are eager to see if we can make headway on helping such children accumulate usable, coherent, and connected knowledge structures. Our initial work with the blatant analogies contained in the Manatees-Kangaroo passages is a first step in this direction. Within the miniature world of these passages, repetitive cases can be recognized and general principles of camouflage, biological deterrants, etc. extracted. Such small "knowledge bundles" are potentially applicable to a wide variety of situations, and we see this as a first step toward the really difficult problem of examining the accumulation of systematic bodies of knowledge, such as basic biological principles. If one is interested in learning, in the sense of the acquisition of generative knowledge structures, we believe that it will be necessary to examine procedures such as those described in this report (e.g., reciprocal teaching, the jigsaw method, etc.) in situations where children are asked to learn principled bodies of knowledge over time.

Finally, the key notion of internalization needs careful consideration. How does process (argument and discussion roles) and knowledge (cases, generalized rules and principles) become

part of a learner's usable knowledge base? If internalization is a prime mechanism of conceptual change, it is little understood. Again, we see no alternative but to study learning taking place within indviduals over time. As a simple example, one might want to teach children rudimentary argument structures and see them practiced extensively in guided oral discussions. Next one might "fade out" the teacher by replacing her with cue cards of the type used by Barnes and Todd (1977) and Scardamalia et al. (1984). If the prompt cards can maintain the discussion, perhaps the next step would be to see if the students can apply their knowledge of argument devices, first with and then without prompts, to the task of written composition. Kneupper (1978) has succeeded in helping college students improve their written composition using Toulmin's (1958) analysis of argument. It remains to be seen whether children can also benefit from systematic instruction, such as a form of reciprocal teaching, in which modelling and support is given for the acquisition of complex argument rules.

Of equal interest is the internalization of knowledge in such a way that the learner establishes ownership over it, i.e., can access it at will and use it to interpret new knowledge, or to provide justification, backing, and warrants in discussions and written compositions. Mechanisms of internalization are central to an understanding of how ownership of knowledge is established and how processes for acquiring knowledge in general

are formed. These are the building blocks, the structure and process, of conceptual change. We believe that observing and assisting children learning in groups will provide important insight into the mechanisms of change.

## References

Anderson, R. C., & Faust, G. W. (1974). Educational psychology: The science of instruction and learning. New York: Dodd Mead.

Aronson, E. (1978). The jigsaw classroom. Beverly Hills, CA: Sage.

Au, K. H. (1980). A test of the social organizational hypothesis: Relationships between participation structures and learning to read. Unpublished doctoral dissertation, University of Illinois.

Bales, R. F. (1950). Interaction process analysis: A method for the study of small groups. Cambridge, MA: Addison-Wesley.

Barnes, D., & Todd, F. (1977). Communication and learning in small groups. London: Routledge & Kegan Paul.

Bereiter, C., & Bird, M. (1985). Use of thinking aloud in identification and teaching of reading comprehension strategies. Cognition and Instruction, 2, 131-156.

Binet, A. (1909). Les idees modernes sur les infants. Paris: Ernest Flammarion.

Bloom, B., & Broder, L. (1950). Problem-solving processes of college students. Chicago: University of Chicago Press.

Boggs, S. T. (1972). The meaning of questions and narratives to Hawaiian children. In C. Cazden, V. John, & D. Hymes (Eds.), Functions of language in the classroom. New York: Teachers College Press.

Bos, M. C. (1937). Experimental study of productive collaboration. Acta Psychologica, 3, 315-426.

Brown, A. L. (1978). Knowing when, where, and how to remember: A problem of metacognition. In R. Glaser (Ed.), Advances in instructional psychology (Vol. 1, pp. 77-165). Hillside, NJ: Erlbaum.

Brown, A. L. (1985). Mental orthopedics: A conversation with Alfred Binet. In S. Chipman, J. Segal, & R. Glaser (Eds.), Thinking and learning skills: Research and open questions (Vol. 2, pp. 319-337). Hillside, NJ: Erlbaum.

Brown, A. L., & Armbruster, B. B., & Baker, L. (in press). The role of metacognition in reading and studying. In J. Orasano (Ed.), Reading comprehension: From research to practice. Hillside, NJ: Erlbaum.

Brown, A. L., Bransford, J. D., Ferrara, R. A., & Campione, J. C. (1983). Learning, remembering, and understanding. In J. Flavell & E. M. Markman (Eds.), Handbook of child psychology (4th ed.). Cognitive development (Vol. 3, pp. 515-629). New York: Wiley.

Brown, A. L., & Campione, J. C. (1981). Inducing flexible thinking: A problem of access. In M. Friedman, J. P. Das, & N. O'Connor (Eds.), Intelligence and learning (pp. 515-529). New York: Plenum Press.

Brown, A. L., Campione, J. C. (1984). Three faces of transfer: Implications for early competence, individual differences, and instruction. In M. Lamb, A. Brown, & B. Rogoff (Eds.), Advances in developmental psychology (Vol. 3, pp. 143-192). Hillside, NJ: Erlbaum.

Brown, A. L., Campione, J. C., & Day, J. D. (1981). Learning to learn: On training students to learn from texts. Educational Researcher, 10, 14-21.

Brown, A. L., & Day, J. D. (1983). Macrorules for summarizing texts: The development of expertise. Journal of Verbal Behavior, 22, 1-14.

Brown, A. L., & Palincsar, A. S. (1982). Inducing strategic learning from texts by means of informed, self-control training. Topics in Learning and Learning Disabilities, 2(1), 1-17.

Brown, A. L., & Palincsar, A. S. (in press). Reciprocal teaching of comprehension strategies: A natural history of one program for enhancing learning. In J. Borkowski & J. D. Day (Eds.), Intelligence and cognition in special children: Comparative studies of giftedness, mental retardation, and learning disabilities. New York: Ablex.

Brown, A. L., Palincsar, A. S., & Purcell, L. (1985). Poor readers: Teach, don't label. In U. Neisser (Ed.), The academic performance of minority children. Hillside, NJ: Erlbaum.

Brown, A. L., & Reeve, R. (in press). Bandwidths of competence: The role of supportive contexts in learning and development. In L. S. Liben & D. H. Feldman (Eds.), Development and learning: Conflict or congruence? Hillside, NJ: Erlbaum.

Bruner, J. (1978). The role of dialogue in language acquisition. In A. Sinclair, R. J. Jarvella, & J. M. Levelt (Eds.), The child's conception of language (pp. 241-256). Berlin: Springer-Verlag.

Bryant, P. (1982). The role of conflict and of agreement between intellectual strategies in children's ideas about measurement. British Journal of Psychology, 73, 243-251.

Carey, S. (1985). Are children fundamentally different kinds of thinkers and learners than adults? In S. F. Chipman, J. W. Segal, & R. Glaser (Eds.), Thinking and learning skills (Vol. 2, pp. 485-517). Hillsdale, NJ: Erlbaum.

Carey, S. (in press). Conceptual change in childhood. Bradford Books.

Case, R. (1985). Intellectual development: A systematic reinterpretation. New York: Academic Press.

Cazden, C. B. (1979). Peekaboo as an instructional model: Discourse development at home and at school. In Papers and reports on child development, (No. 17 pp. 1-19). Stanford, CA: Department of Linguistics, Stanford University.

Cazden, C. B. (1984). Classroom discourse. In M. C. Wittrock (Ed.), Handbook of research and teaching. New York: MacMillan.

Chukovsky, K. (1968). From 2 to 5. Berkeley: University of California Press.

Cole, M., & Bruner, J. S. (1971). Cultural differences and inferences about psychological processes. American Psychologist, 26, 867-876.

Cole, M., & Scribner, S. (1975). Theorizing about socialization of cognition. Ethos, 3, 249-268.

Collins, A., & Stevens, A. (1982). Goals and strategies of inquiry teachers. In R. Glaser (Ed.), Advances in instructional psychology (Vol. 2, pp. 65-119). Hillside, NJ: Erlbaum.

Curtis, M. E. (1980). Development of components of reading skill. Journal of Educational Psychology, 72, 656-669.

Dashiell, J. F. (1935). Experimental studies of the influence of social situations on the behavior of individual human adults. In C. Murchison (Ed.), Handbook of social psychology. Worchester, MA: Clark University Press.

Davis, R. B. (1966). Discovery in the teaching of mathematics. In L. S. Shulman & E. R. Keisler (Eds.), Learning by discovery: A critical appraisal. Chicago: Rand McNally.

DeVries, D. L., Slavin, R. E., Fennessey, G. M., Edwards, K. J., & Lombardo, M. M. (1980). Teams-Games-Tournament: The team learning approach. Englewood Cliffs, NJ: Educational Technology Publications.

Dewey, J. (1910). How we think. Boston: Heath. (2nd ed., Heath, 1933).

Doise, W., & Mugny, G. (1984). The social development of the intellect. New York: Pergamon Press.

Dumont, R. V. (1972). Learning English and how to be silent: Studies in Sioux and Cherokee classrooms. In C. Cazden, V. John, & D. Hymes (Eds.), Functions of language in the classroom. New York: Teachers College Press.

Dunkin, M. J. & Biddle, B. J. (1974). The study of teaching. New York: Holt, Rinehart, & Winston.

Durkin, D. (1984). Do basal manuals teach reading comprehension? In R. C. Anderson, J. Osborn, & R. J. Tierney (Eds.), Learning to read in American schools: Basal readers and content texts (pp. 29-38). Hillside, NJ: Erlbaum.

Dweck, C. (1985). Motivation. In R. Glaser & A. Lesgold, The handbook of psychology and education. Hillside, NJ: Erlbaum.

Erickson, F. & Schultz, J. (1977). When is a context? Some issues and methods on the analysis of social competence. Quarterly Newsletter of the Institute for Comparative Human Development, 1, 5-10.

Fischer, K. W. (1980). A theory of cognitive development: The control and construction of hierarchies of skills. Psychological Review, 87, 477-531.

Gagne, R. M. (1965). The conditions of learning. New York: Holt, Rinehart, & Winston.

Gelman, R., & Brown, A. L. (in press-a). Early foundations of cognitive development. The 1985 Annual Report for Center for Advanced Study in the Behavioral Sciences, Stanford, CA.

Gelman, R., & Brown, A. L. (in press-b). Changing views of cognitive competence in the young. In N. J. Smelser & D. R. Gerstein, Knowledge in the Social and Behavioral Sciences: Discovery and trends over fifty years (Proceedings of a Commemorative Symposium on the Fiftieth Anniversary of the Ogburn Report, Recent Social Trends in the United States). New York: Academic Press.

Glachan, M. (1982). Peer interaction: Its role in cognitive development. Unpublished doctoral dissertation. University of Southampton, England.

Glachan, M. & Light, P. H. (1982). Peer interaction and learning. In G. E. Butterworth & P. H. Light (Eds.), Social cognition: Studies of the development of understanding. Brighton: The Harvester Press.

Greenfield, P. M. (1984). A theory of the teacher in the learning activities of everyday life. In B. Rogoff & J. Lave (Eds.), Everyday cognition: Its development in social context (pp. 117-138). Cambridge, MA: Harvard University Press.

Griffen, P. & Cole, M. (1984). Current activity for the future: The Zo-ped. In B. Rogoff & J. V. Wertsch (Eds.), Children's learning in the "zone of proximal development". San Francisco: Jossey-Bass.

Grize, J. B. (1982). De la logique a° l'argumentation. Paris-Geneve°.

Harris, P. L., Kruithof, A., Terwogt, M. M., & Visser, P. (1981). Children's detection and awareness of textual anomaly. Journal of Experimental Child Psychology, 31, 212-230.

Hatano, G. (1982). Cognitive consequences of practice in culture specific procedural skills. Quarterly Newsletter of the Laboratory of Comparative Human Cognition, 4, 15-18.

Heath, S. B. (1981). Questioning at home and at school: A comparative study. In G. Spindler (Ed.), Doing ethnography: Educational anthopology in action. New York: Holt, Rinehart, & Winston.

Humphreys, L. G., & Parsons, C. A. (1979). A simplex model to describe differences between cross lagged correlations. Psychological Bulletin, 86, 325-334.

Inagaki, K., & Hatano, G. (1983). Collective scientific discovery by young children. The Quarterly Newsletter of the Laboratory of Comparative Human Cognition, 5, 13-18.

Inhelder, B., Sinclair, H., & Bovet, M. (1974). Learning and the development of cognition. Cambridge, MA: Harvard University Press.

Johnson, D. W. & Johnson, R. T. (1974). Conflict in the classroom: Controversy and learning. Review of Educational Research, 49, 51-70.

Johnson, D. W. & Johnson, R. T. (1975). Learning together and alone. Englewood Cliffs, NJ: Prentice-Hall.

Karmiloff-Smith, A., & Inhelder, B. (1974/75). If you want to get ahead, get a theory. Cognition, 3, 195-212.

Kelley, H. H., & Thibaut, J. W. (1954). Experimental studies of group problem solving. In G. Lindzey (Ed.), Handbook of social psychology (Vol. 2). Reading, MA: Addison-Wesley.

Kelley, H. H., & Thibaut, J. W. (1969). Group problem-solving. In G. Linzey (Ed.), Handbook of social psychology (Vol. 4). Cambridge, MA: Addison-Wesley.

Kneupper, C. W. (1978). Teaching argument: An introduction to the Toulmin model. College Composition and Communication, 29, 237-241.

Kuhn, T. S. (1962). The structure of scientific revolutions. Chicago: University of Chicago Press.

Lave, J. (1977). Tailor-made experiences in evaluating the intellectual consequences of apprenticeship training. Quarterly Newsletter of Institute for Comparative Human Development, 1, 1-3.

Lave, J., Murtaugh, M., & de la Rocha, O. (1984). The dialectic of arithmetic in grocery shopping. In B. Rogoff & J. Lave (Eds.), Everyday cognition: Its development in social context (pp. 67-94). Cambridge, MA: Harvard University Press.

Mehan, H. (1979). Learning lessons: Social organization in the classroom. Cambridge: Harvard University Press.

Meichenbaum, D. (1977). Cognitive behavior modification: An integrative approach. New York: Plenum Press.

Mohatt, G. V., & Erickson, F. (1982). Cultural differences in teaching styles in an Odawa school: A sociolinguistic approach. In H. T. Trueba, G. P. Guthrie, & K. H. Au (Eds.), Culture in the bilingual classroom. Rowly, MA: Newbury House.

Palincsar, A. S. (in press). The role of dialogue in scaffolded instruction. Educational Psychologist.

Palincsar, A. S., & Brown, A. L. (1984). Reciprocal teaching of comprehension-fostering and monitoring activities. Cognition and Instruction, 1(2), 117-175.

Palincsar, A. S., & Brown, A. L. (1985). Reciprocal teaching: Activities to promote "reading with your mind." In E. J. Cooper (Ed.), Reading, thinking, and concept development: Interactive strategies for the class. New York: College Board.

Palincsar, A. S., & Brown, A. L. (in press). Interactive teaching to promote independent learning from text. The Reading Teacher.

Paley, V. (1981). Wally's stories. Cambridge, MA: University of Harvard Press.

Perret-Clermont, A. N. (1980). Social interaction and cognitive development in children. London: Academic Press.

Philips, S. (1972). Participant structures and communicative competence. In C. Cazden, V. John, & D. Hymes (Eds.), Function of language in the classroom. New York: College Press.

Piaget, J. (1926). The language and thought of the child. London: Routledge & Kegan Paul.

Piaget, J. (1950). The psychology of intelligence. London: Routledge & Kegan Paul.

Piaget, J. (1967). Biologie et connaissance. Paris: Gallimard.

Piaget, J. (1976a). Postscript. Archives de Psychologie, 44, 223-228.

Piaget, J. (1976b). The grasp of consciousness: Action and concept in the young child. Cambridge, MA: Harvard University Press.

Pontecorvo, C. (1985, June). Discussing for reasoning: The role of argument in knowledge construction. Paper presented at the European Association for Research on Learning and Instruction. Leuven, Belguim.

Russell, J. (1981). Dyadic interaction in a logical reasoning problem requiring inclusion ability. Child Development, 52, 1322-1325.

Russell, J. (1982a). Cognitive conflict, transmission, and justification: Conservation attainment through dyadic interaction. Journal of Genetic Psychology, 140, 283-297.

Russell, J. (1982b). Prepositional attitude. In M. Beveridge (Ed.), Children's thinking through language. London: Edward Arnold.

Scardamalia, M. (1981). How children cope with the cognitive demand of writing. In C. H. Frederiksen, M. F. Whiteman, & J. F. Dominic (Eds.), Writing: the nature, development, and teaching of written composition. Hillside, NJ: Erlbaum.

Scardamalia, M., Bereiter, C., & Steinbach, R. (1984). Teachability of reflexive processes in written composition. Cognitive Science, 8, 173-190.

Scollon, R. (1976). Conversations with a one-year-old. Honolulu: University Press of Hawaii.

Sharan, S. (1980). Cooperative learning in small groups: Recent methods and effects on achievement, attitudes, and ethnic relations. Review of Educational Research, 50, 241-271.

Sharan, S. & Sharan, Y. (1976). Small-group teaching. Englewood Cliffs, NJ: Educational Technology Publications.

Shaw, M. E. (1932). A comparison of individual and small groups in the rational solution of complex problems. American Journal of Psychology, 44, 491-504.

Slavin, R. E. (1983). Cooperative learning. New York, NJ: Longman, Inc.

Toulmin, S. (1958). The uses of argument. Cambridge: Cambridge University Press.

Van Ness, H. (1982). Social control and social organization in an Alaskan Athabascan classroom: A microethnography of getting ready for reading. In H. T. Trueba, G. P. Guthrie, & K. H. Au (Eds.), Culture in the bilingual classroom. Rowley, MA: Newbury House.

Von Wright, G. H. (1971). Explanation and understanding. New York: Cornell University Press.

Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes (M. Cole, V. John-Steiner, S. Scribner, & E. Souberman, Eds.). Cambridge, MA: Harvard University Press.

Webb, N. (1984). Peer interaction and learning in cooperative small groups. Journal of Educational Psychology, 76, 333-344.

Wertsch, J. V. (1984). The zone of proximal development: Some conceptual issues. In B Rogoff & J. Wertsch (Eds.), Children's learning in the "zone of proximal development" (pp. 7-18). San Francisco: Jossey-Bass.

Wertsch, J. V., & Stone, C. A. (1979, February). A social interactional analysis of learning disabilities remediation. Paper presented at the International Conference of the Association for Children with Learning Disabilities. San Francisco.

Whimbey, A., & Lochhead, J. (1978). Problem-solving and comprehension: A short course in analytical reasoning. Philadelphia: Sue Franklin Institute Press.

Whitehead, A. N. (1916). Address to the British Mathematical Society. Manchester, England.

Wood, D. J. (1980). Teaching the young child: Some relationships between social interaction, language, and thought. In D. R. Olson (Ed.), The social foundations of language and thought. New York: Norton.

Wood, P., Bruner, J., & Ross, G. (1976). The role of tutoring in problem-solving. Journal of Child Psychology and Psychiatry, 17, 89-100.

Wood, D., & Middleton, D. (1975). A study of assisted problem-solving. British Journal of Psychology, 66, 181-191.

Yager, S., Johnson, D. W., & Johnson, R. T. (1985). Oral discussion, group to individual transfer, and achievement in cooperative learning groups. Journal of Educational Psychology, 77, 60-66.

Figure Captions

Figure 1. Independent learning scores of the junior high school students (N = 150) taking part in a reading conducted by regular classroom teachers.

Figure 2. Independent learning scores of four groups of matched junior high school students. RT = students taught by volunteer teachers using the reciprocal teaching procedures; LI = students taught in a procedure that provided guided practice locating information to answer text questions; T = students who took all the independent tests but received no training; and C = an untreated control group. A refers to the level of performance set by average and above average students on the test passages (from Palincsar & Brown, 1984).

Figure 3. Independent learning of three groups of matched junior high school students receiving strategy training and an untreated control.

Figure 4. Transfer measures taken from reciprocal teaching students taught by volunteer teachers (from Palincsar & Brown, 1984).

Figure 5. Independent learning scores of the six first grade students whose discussions are featured in Tables 3-5. The left hand panel contains individual learning curves. The data in the right hand panels are the average performance of the six children when they served as an untreated control and when they were taught by the reciprocal teaching procedure.

Figure 6. Independent learning scores of all students taking part in the first grade classroom listerning study (96 students in reciprocal teaching and 48 control students).

Figure 7. Transfer performance on tests of the four component strategies after twenty days of reciprocal teaching.

Table 1. Reciprocal Dialogue from an Early Session (Day 3)

| TEXT: | CAN SNAKES STING WITH THEIR TONGUES?<br>No--snakes' tongues are completely harmless. They're used for feeling things and for sharpening the snakes' sense of smell. Although snakes can smell in the usual way, the tongue flickering in the air picks up tiny particles of matter. These particles are deposited in two tiny cavities at the base of the nostrils to increase the snakes's ability to smell. |
|---|---|

1. A: Do snakes' tongues sting?
2. K: Sometimes.
3. A: Correct.
   This paragraph is about do snakes sting with their tongue, and different ways that the tongue is for and the senses of smell.
4. *T: Are there any questions?
5. C: Snakes' tongues don't sting.
6. *T: Beautiful! I thought, boy, I must have been doing some fast reading there because I missed that point. A_____, could you ask your question again?
7. A: Do snakes' tongues really sting?
8. *T: Now, A_____, since you have asked the question, can you find in that paragraph where the question in answered?
9. A: No, snakes' tongues are completely harmless.
10. *T: So we'll try it again. Can you generate another question that you think a teacher might ask?
11. A: What are the tongues used for?
12. *T: Good!
13. L: The sense of smell.
14. *T: Is that correct? A_____, do you disagree? Yes.
15. A: That answer was right, but there are other things that the tongue can do.
16. L: But she only said tell one, she didn't say tell all of them.
17. *T: O.K.
18. B: It is used to pick up tiny particles.
19. *T: O.K. I think that this is an important point. You have the basic concept which is correct, O.K., but what the question really is saying is, is it used for smell? O.K.?
20. B: They are used for feeling things for sharpening snakes' sense of smell.
21. *T: O.K. They are used for sharpening the snakes' sense of smell. Are they used for smelling? That's the point we aren't clear on.
22. L: In my answer I said it is for the sense of smell.
23. *T: This is fine; this is what the technique is all about. What it means is not that you are right or wrong or good or bad. What it says is that we have just read something and have had a disagreement about what it says. We need to work it out.
24. A: My prediction is that they will now talk about the different things about snakes. Where they live, and what they eat and stuff like that.
25. *T: O.K. Good. What do you think they eat?
26. A: Animals.
27. A: Deserts.
28. C: I challenge. Snakes, all of them, don't live in the desert. They live in the woods and in swamp areas.

* Indicates turns taken by adult teacher

Table 2. Reciprocal Dialogue from a Later Session; Study 2, Group 3, Day 13

| | |
|---|---|
| Text: | In the United States salt is produced by three basic methods: solar (sun) evaporation, mining, and artificial heat evaporation. For salt to be extracted by solar evaporation, the weather must be hot and dry. Thus, solar salt is harvested in the tropic-like areas along our southern ocean coasts and at Great Salt Lake. |

1. C: Name three different basic methods how salt is produced.
2. A: Evaporation, mining, evaporation ... artificial heat evaporation.
3. C: Correct, very good. My summary on this paragraph is about ways that salt is being produced.
4. *T: Very good. Could you select the next teacher? (Student selects another student)

Text: The second oldest form of salt production is mining. Unlike early methods that made the work extremely dangerous and difficult, today's methods use special machinery, and salt mining is easier and safer. The old expression "back to the salt mine" no longer applies.

5. L: Name two words that often describe mining salt in the old days.
6. K: Back to the salt mines?
7. L: No. Angela?
8. A: Dangerous and difficult.
9. L: Correct. This paragraph is all about comparing the old mining of salt and today's mining of salt.
10. *T: Beautiful!
11. L: I have a prediction to make.
12. *T: Good.
13. L: I think it might tell when salt was first discovered, well, it might tell what salt is made of and how it's made.
14. *T: O.K. Can we have another teacher?

| | |
|---|---|
| Text: | Table salt is made by the third method — artificial evaporation. Pumping water into an underground salt bed dissolves the salt to make a brine that is brought to the surface. After purification at high temperatures, the salt is ready for our tables. |

15. K: After purification at high temperatures the salt is ready for what?
16. C: Our tables.
17. K: That's correct. To summarize: After its purification, the salt is put on our tables.
18. *T: That was a fine job, Ken, and I appreciate all that work, but I think there might be something else to add to our summary. There is more important information that I think we need to include. This paragraph is mostly about what?
19. A: The third method of artificial evaporation.
20. B: It mainly tells about pumping water from an underground salt bed that dissolves the salt to make a brine that is brought to the surface.
21. *T: Angela hit it right on the money. This paragraph is mostly about the method of artificial evaporation and then everything else in the paragraph is telling us about that process. O.K. Next teacher.

Table 2 (cont' d)

| | |
|---|---|
| Text: | For thousands of years people have known salt--tasting it, using it for their lives' needs. Sometimes it has been treasured as gold; other times it has been superstitiously tossed over the shoulder to ward off bad luck. Somehow people and salt have always been together, but never is the tie more complete than when the best people are called "the salt of the earth." |

22. C: My question is, what are the best people called?
23. L: The salt of the earth.
24. C: Why?
25. L: Because salt and the people have been together so long.
26. *T: Chris, do you have something to add to that? O.K. It really isn't because they have been together so long; it has to do with something else. Brian?
27. B: (reading) "People and salt have always been together but never has the tie been so complete."
28. *T: Allright, but when we use the expression, "That person is the salt of the earth," we know that means that person is a good person. How do we know that?
29. B: Because we treasure salt, like gold.

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* Indicates turns taken by adult teacher

Table 3

First Grade Listening Comprehension, Day 18

READING

Behind the front legs there are two odor glands. They look like two extra eyes. To protect itself a Daddy Long Legs can give off a smelly liquid from these glands. Birds, toads, and large insects don't like it at all. It makes them feel too sick or too weak to try to catch the Daddy Long Legs.

1. D: [QUESTION] What does the Daddy Long Legs do when something comes around it. Justin?
2. J: Use that odor gland... not audible.
3. D: Yeah. Charlie.
4. C: When a animal comes along, he puts out his odor and they get too sick to catch him.
5. D: Yeah. Mara.
6. M: Or too weak.
7. R: They feel too weak and too sick.
8. D: Everybody gave me good answers.
9. *T: Very good.
10. D: [SUMMARY] I will summarize. When a animal comes around, it gives out its bad smell, and they get too weak and too old to catch it.
11. M: [CLARIFICATION] Who does?
12. D: That's the Daddy Long Legs.
13. M: [CLARIFICATION] Who does?
14. D: The animals.
15. M: [CLARIFICATION] Which animals?
16. D: All kinds of animals.
17. R: Yeah, different kinds.
18. D: Different kinds of animals put out a spray?
19. R: [CLARIFICATION] Om, it might be the same kind of animal as trys to catch the Daddy Long Legs.
20. *T: Ok, I think you are talking about two different things. He's talking about the animals that come around to the spider and he's trying to get you to say who puts out the odor. Is it all animals?
21. D: No (emphatic). It's the Daddy Long Legs -- Sigh (exasperated)

Table 4

First Grade Listening Comprehension, Day 19

READING
Daddy Long Legs are related to spiders.

1. S: [CLARIFICATION] What does related mean?
2. *T: What do you think, Charlie?
3. C: Sort of like, they're the same kind of animal, sort of like. Like, tigers are related to cats.
4. *T: Very good. They may not be in the same family, but they are similar.

READING
Daddy Long Legs are related to spiders, but they are not true spiders. Daddy Long Legs don't spin webs to trap insects for food the way spiders do. Daddy Long Legs go out hunting for their food. Daddy Long Legs never bite people and they are never poisonous.

5. S: [QUESTION] Are the spiders ever poisonous or not? Mara.
6. M: They aren't.
7. D: I did have a different question.
8. *T: Ok.
9. D: [QUESTION AND CLARIFICATION] If the spiders didn't spin a web for their food, how did they get their food?
10. M: Oh, that's a terrific question.
11. *T: It sure is, isn't it?
12. D: Justin.
13. J: They went out hunting.
14. D: Yeah.
15. *T: And you said you even had a different question.
16. C: [QUESTION AND CLARIFICATION] If they didn't catch them and the spider didn't bite them, what did he do?
17. *T: I'm a little confused.
18. S: I think he was talking about how they catch their food without biting them.
19. *T: Does the story really tell us? It just says they go hunting for it, doesn't it? I think, does it say that a Daddy Long Legs never bites its food?
20. ALL: No.
21. *T: What did it say it never bites?
22. M: It never bites people.
23. *T: All right. So, I imagine if it is going out hunting, Charlie, if it wants to eat it has to bite, doesn't it?
24. S: I forgot to summarize.
25. *T: Oh, I don't think you did, we just haven't gotten there. Now you can do it for us.
26. S: [SUMMARY] We learned that the Daddy Long Legs aren't poisonous.
27. *T: Great. Anything else you think it's important to remember. Did we learn anything about how they eat? How they get their food or how they are different from spiders?
28. J: They don't spin webs. They hunt for their food.
29. *T: Very good. All right. So, what you might want to do is remember, if you see a Daddy Long Legs are you going to call it a spider.
30. ALL: NO
31. S: [SUMMARY] No, because it doesn't spin a web. And it hunts for its food and it's not poison.

Table 5

First Grade Listening Comprehension, Day 20

READING

Ten to twenty Daddy Long Legs can live together in this cage. It is fun to watch them at night. They are more active then. They rest during the day. If you look into your Daddy Long Legs cage when they are resting, your shadow will wake them suddenly. Then they will scamper around the cage, bouncing up and down in their funny dance. A few minutes later, they will all be resting quietly again.

1. S: [QUESTION] How many spiders can fit in a cage?
2. R: It didn't tell.
3. S: Yes it did.
4. J: Reggie doesn't think it told us.
5. S: Charlie?
6. C: About ten or so.
7. S: Mara?
8. M: Ten to twenty.
9. *T: Ten to twenty. Daryl, do you have a different one? What question would you ask?
10. D: [QUESTION] If you came by and looked, if you came by and looked in the Daddy Long Legs cage, what would the Daddy Long Legs do? Justin?
11. J: Your shadow would wake him up and then they would start scampering around and...
12. M: And in a little bit all of them will lay down and go back to sleep again.
13. D: He kind of left some out.
14. *T: What did he leave out?
15. D: When they bounce up and down.
16. *T: In a funny dance, right. That was a good question, Daryl. And, Justin, I like the way you brought in the use of shadow. That's good too. All right.
17. S: [SUMMARY] I learned that over ten to twenty Daddy Long Legs could fit in a cage.
18. *T: And can you include the information that Daryl brought with his question?
19. S: [SUMMARY] If your shadow goes on the Daddy Long Legs it moves around. And they do a funny dance and scamper around.
20. *T: Good job, Susan. I might have also asked the question, when is the best time to watch your Daddy Long Legs if you catch one? Mara?
21. M: When it's night?
22. *T: Do you remember why? Charlie, do you?
23. C: They're more active.
24. *T: What does that mean? More active.
25. C: It means they move more than they do in the day.

Table 6

First Grade Listening Comprehension, Day 20 (cont'd)

READING

Keep the cage in a cool, shady place, so the sand won't dry out. Daddy Long Legs need a lot of moisture. They are always thirsty. Their second legs help them find water. Daddy Long Legs can't swim, but they can stand on water. They often stand on top of the water to drink. If direct sun ever shines on the cage, the Daddy Long Legs will curl up and die. They don't mind the cold so long as it is damp. After you have watched your Daddy Long Legs for a few days, set them free outside. You can catch more any time you like.

1. D: [QUESTION] What does it do when you watch it too long.
2. M: It didn't tell anything about it.
3. D: [QUESTION] What can, what can the Daddy Long Legs do with water?
4. C: He can stand up and drink.
5. D: Yeah.
6. S: [CLARIFICATION] Does it stand up and drink?
7. *T: You don't think it stands up? What would you say?
8. S: It stands in the water and drinks.
9. *T: I thought it was something very interesting about that water and the spider. Do you remember?
10. *T: Daddy Long Legs can't do something.
11. M: Swim.
12. *T: They couldn't swim. I'm glad you remembered that. But they can stand...on the water! Do you think that's unusual?
13. ALL: Yeah!
14. M: Nobody can stand on the water.
15. *T: People can't
16. C: Not even people could because we're too heavy to stand on water.
17. *T: Do you have a different question that you would have asked, Reggie? What's your question that you would have asked?
18. R: [QUESTION] What would hurt the Daddy Long Legs?
19. *T: That's a good question.
20. R: [QUESTION] Or kill the Daddy Long Legs?
21. C: [CLARIFICATION] I don't understand that.
22. *T: Charlie didn't understand your question. Would you say it one more time?
23. R: [QUESTION] What kills the Daddy Long Legs? Charlie?
24. C: The water.
25. R: Nope.
26. R: Susan?
27. S: The sun.
28. R: Yeah.
29. S: But um, and you got to let it go so you could catch more Daddy Long Legs.
30. *T: All right, is that sort of what you meant by your first question, Daryl? What would happen if you watched it too long?
31. D: Yeah. It curls up and dies.
32. D: [SUMMARY] I would summarize that the Daddy Long Legs, it can stand on the water and drink it. And it can't swim. And if you, the sun kills it. — And you have to let it go, so you can catch more.

Table 7

First Grade Listening Comprehension (Day 19)

READING

The dull coloring of the Daddy Long Legs is another way it is protected from its enemies. Daddy Long Legs are awfully hard to see as they wobble along in the grass.

1. R: [QUESTION] Can you see them very good? Justin.
2. J: No.
3. R: Right Justin.
4. *T: And as the teacher you might want to know a little bit more.
5. R: But you could see him in the light but you can't really see them in the dark when they wobble along.
6. J: Om, cause they already have black on them.
7. *T: What makes you think they have black on them?
8. R: Because they have hair.
9. *T: Was there a clue here that I gave you that made you know that they were not easy to see?
10. ALL: Yeah
11. *T: What was it?

(interruption clarifying the word wobble)

12. M: [CLARIFICATION] We can't tell why it's hard to see.
13. *T: There's a clue
14. M: [CLARIFICATION] Read it again.
15. *T: All right. [REREADING] "The dull coloring of the Daddy Long Legs is another way that it is protected from its enemies."
16. M: Dull! it's dull.
17. *T: Reggie, what does dull mean?
18. R: Protected.
19. *T: Does it mean that it's protected? How is it protected?
20. D: By its spray (referring to text content covered on the previous day)
21. *T: Well, we know it is protected by its odor, but that's not what it's talking about here. Maybe you should have asked me to clarify what dull means? I'm not saying d[illegible] like a doll you play with. A DULL coloring. Mara.
22. M: It means it's sort of like, dark paint.
23. *T: If you were a spider walking along on the top of the grass or a Daddy Long Legs and you didn't want to be seen, what kind of coloring would you have? A bright orange?
24. J: Green.
25. *T: Bright red or yellow.
26. J: NO
27. M: I would be black.
28. J: Black and green.
29. *T: Oh, when you said it probably was black, I thought maybe you were thinking of this part of the story.
30. M: A dark black.
31. *T: A dark color, or you said another color would be good.
32. J: Green
33. *T: Green would be a good color?

34. J: Cause the grass is green.
35. *T: Right, all right. So, dull just means it's sort of dim and dark and not real bright and noticeable. It sort of blends in. OK, it's not a very exciting color at all. And those of you that have really seen Daddy Long Legs?
36. D: It's sort of brownish.
37. M: It's sort of blackish.
38. *T: All right, would you be teacher for this part, Susan?
39. R: I need to summarize.
40. *T: Oh, you didn't summarize, thank you. How are you going to summarize?
41. R: [SUMMARY] I summarize that we learned that Daddy Long Legs wobbles on top of the g. ass.
42. *T: Was that the most important part on what you asked about? You're right, but we learned something very important.
43. R: [SUMMARY] It blends in with the grass, so you can't see it. That's part of its protection.
44. *T: All right.
45. J: He could have put it might be green or black.
46. *T: He could have put that in, but did the story really tell us the colors?
47. M: It said dull, dull like black paint.
48. *T: Well, that's what we thought, wasn't it? But what Reggie said was right, it blends in so that it is hard to see. That was an excellent summary.

Table 8

First Grade Listening Comprehension (Day 20)

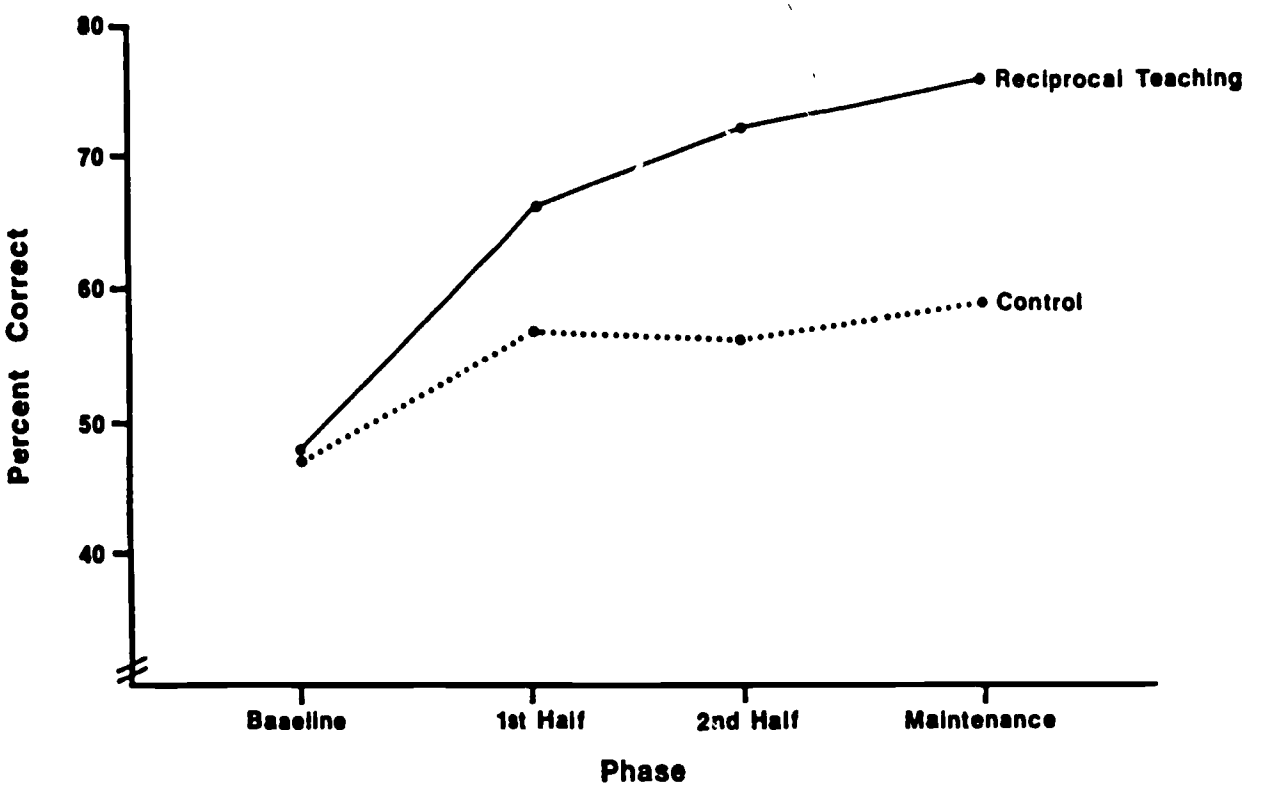
READING

To learn more about Daddy Long Legs, you could go out and catch some. Early Fall is the best time. Look on dark, damp walls, outside cellar windows, or near rain spouts.

1. R: [CLARIFICATION] What are rain spouts?
2. *T: All right, does anyone know what a rain spout is?
3. D: Rain spouts?
4. *T: It says to look near rain spouts. Do you now what a rain spout is -- remember the song we sang? (singing) I'm a little teapot, short and stout. Here's my handle, here's my spout.
5. M: It's the thing you pour.
6. *T: Right, that's where the tea poured out of the teapot. Well, then, what would a rain spout be?
7. M: Oh, I know.
8. *T: Mara?
9. M: It's a tube that rain falls through -- instead of falling inside of your house.
10. D: [CLARIFICATION] Do you mean they're on your houses?
11. *T: What would you call the tube that goes round your house and collects the rain so it doesn't go into your house? But it takes it out to the yard.
12. C: Rain spouts.
13. *T: Have you heard of gutters?
14. R: Yeah.
15. *T: Well, some people call them rain spouts. All right. Now, have we made you forget your question, Reggie? Or do you still have one in mind?
16. R: I forgot.
17. *T: All right, this was a short part, so I'll reread it. [REREAD] "To learn more about Daddy Long Legs, you could go out and catch some. Early Fall is the best time. Look on damp, dark walls, outside cellar windows, or near rain spouts."
18. R: [QUESTION] Why was Fall the best time to look for tne Daddy Long Legs?
19. D: Where the sun is out.
20. M: No! -- and he said why.
21. *T: You don't think he should say why? Or you mean Daryl didn't answer why?
22. M: He didn't answer why.
23. R: Mara, when?
24. M: In the Fall. Oh, early Fall.
25. *T: What else did it tell us then?
26. M: Where to find them.
27. *T: Where to find them. Good. So, instead of saying when, you could have asked a question starting with where. What would that have been, Reggie?
28. R: Where to find them.
29. *T: Okay, make up a question using all the information.
30. R: [QUESTION] Where could you find all them spiders?
31. D: [CLARIFICATION] Spiders?

(interruption centered on an argument between Daryl, Mara and Reggie concerning whether Daddy Long Legs are true spiders. This discussion referred back to text content covered two days earlier.)

32. *T: Do you want to try it again? I bet you can do it this time. Let's have one last try at your question, Reggie.
33. R: [QUESTION] Where could you find the Daddy Long Legs?
34. D: That's much better.
35. J: Near water spouts.
36. *T: [CLARIFICATION] All right, I want you to listen to this one sentence once more, and I want you to help me with a word that I don't quite understand. Look on dark, damp walls outside cellar windows --
37. M: Oh! Oh! I know. What does cellar mean?
38. *T: Too late, I'm asking you, what does cellar mean, Daryl?
39. D: It's sort of like a jail where you take people when they did something wrong.
40. *T: That might have happened in olden days. Now where is the cellar usually located?
41. S: In southern states.
42. *T: We call them by other names...(pause)...You have to go down the stairs.
43. D: Oh, basements.
44. M: Dark and damp, dark and damp.
45. D: That's it, basements.
46. *T: We call them basements. Yes. Now that would have been a good thing to have asked me earlier. If you didn't understand what cellar windows were, you should have asked. That would have been a good question, clarification question.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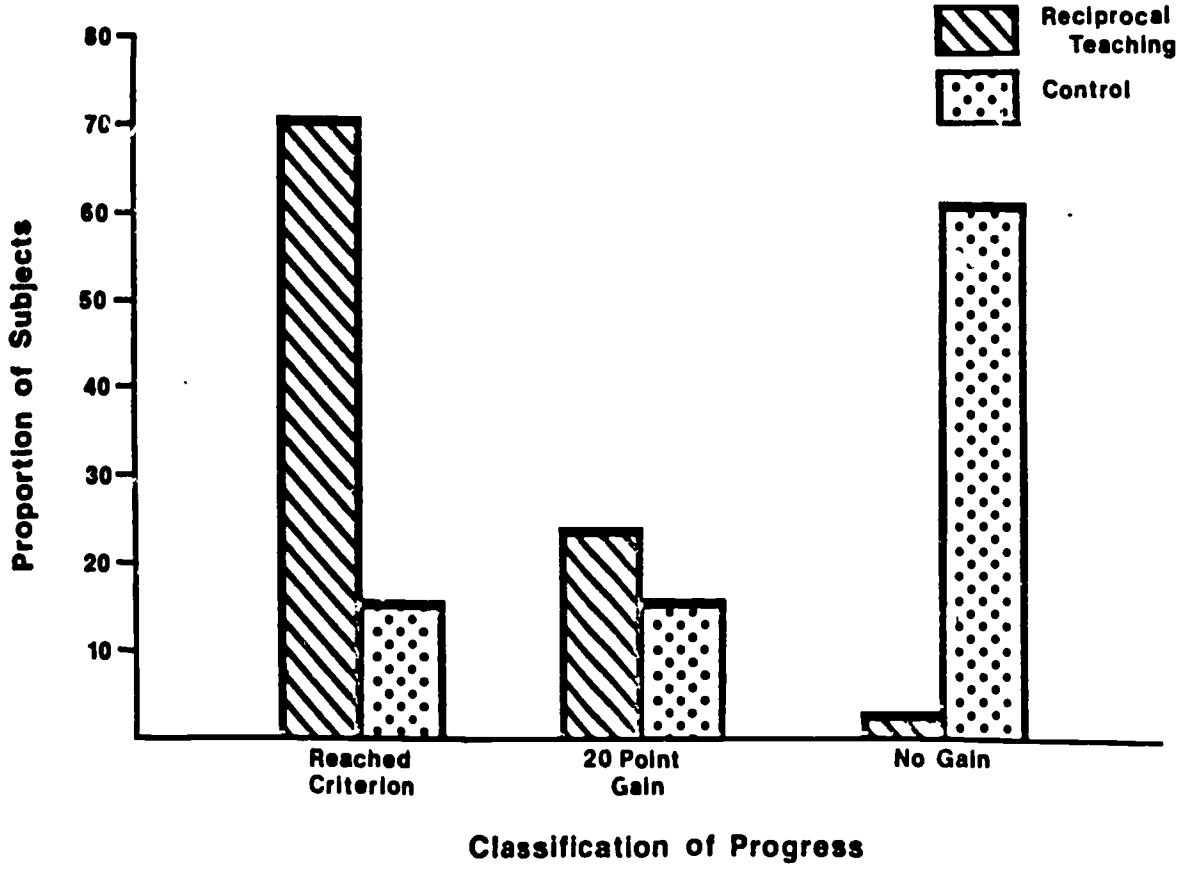
Percent Correct
Reciprocal Teaching
Control
Baseline
1st Half
2nd Half
Maintenance
Phase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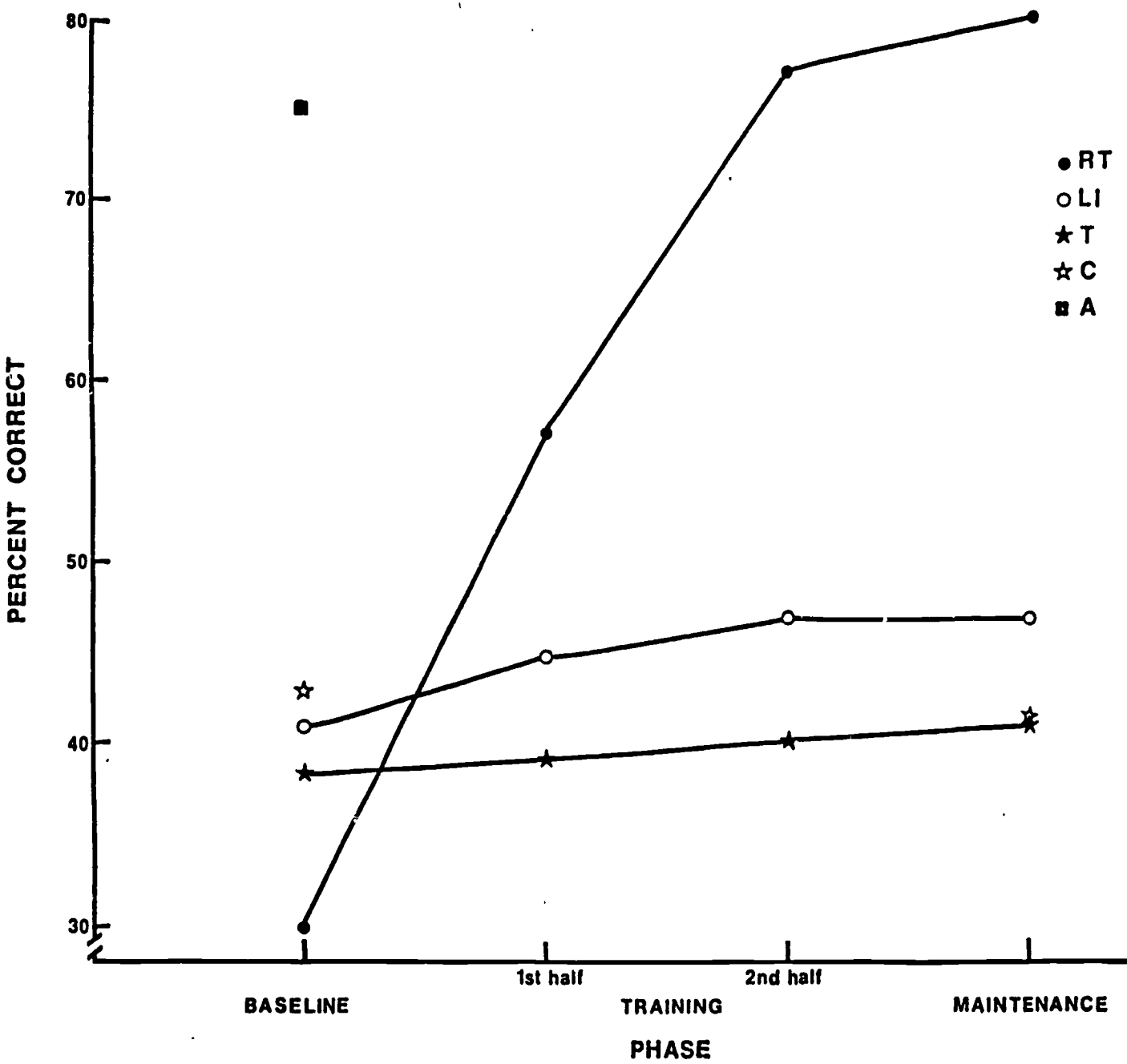
Proportion of Subjects
Reached Criterion
20 Point Gain
No Gain
Classification of Progress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TRAINING
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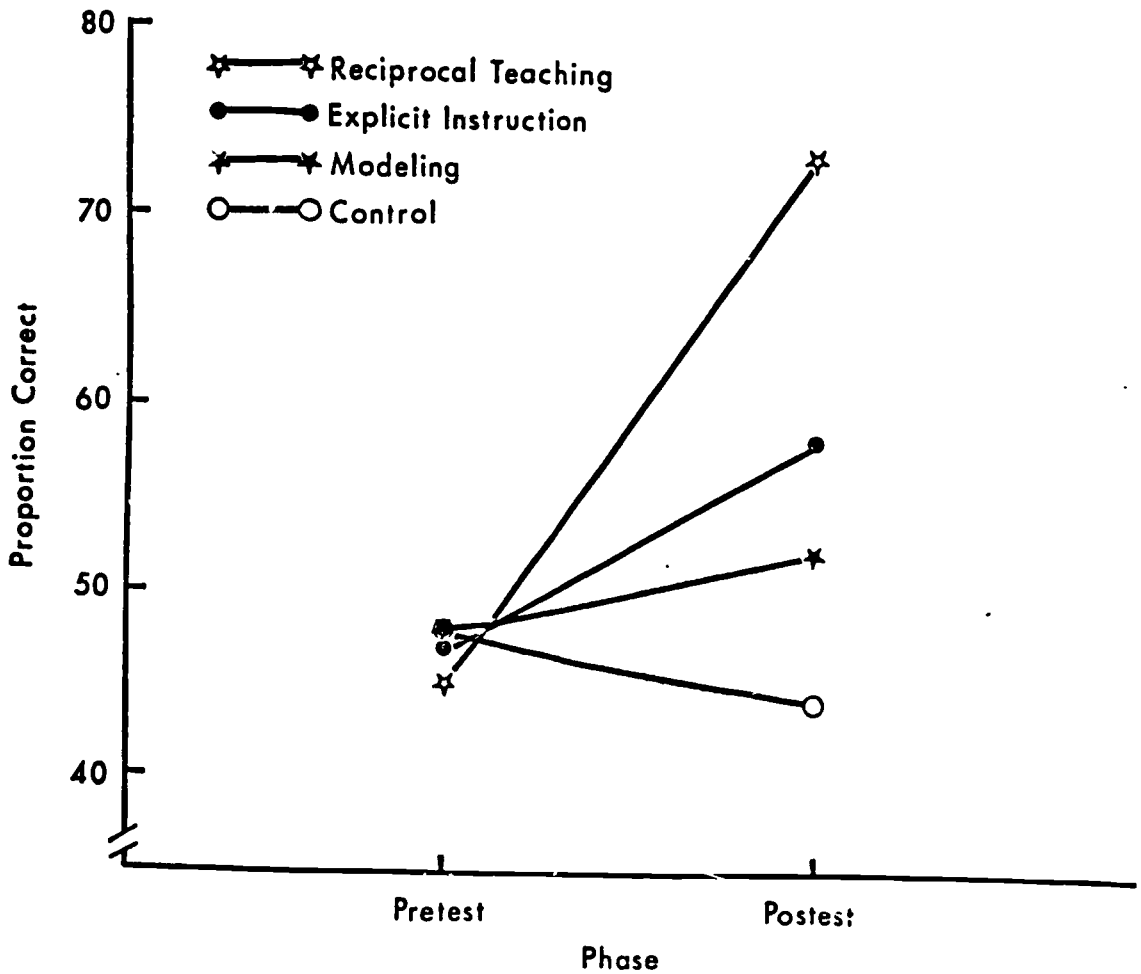
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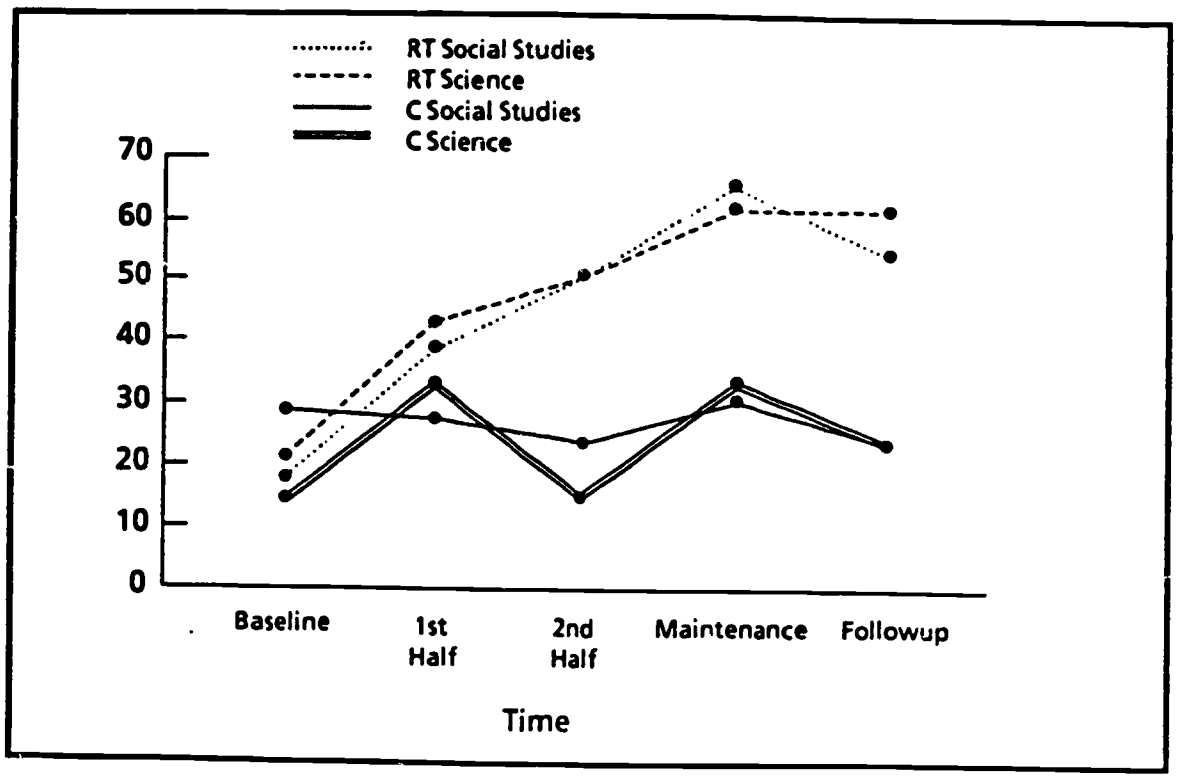
Proportion Correct
Reciprocal Teaching
Explicit Instruction
Modeling
Control
Pretest
Postest
Phase

## Classroom Generalization Data

1) Classroom Probes




2) Changes in Percentile Rankings

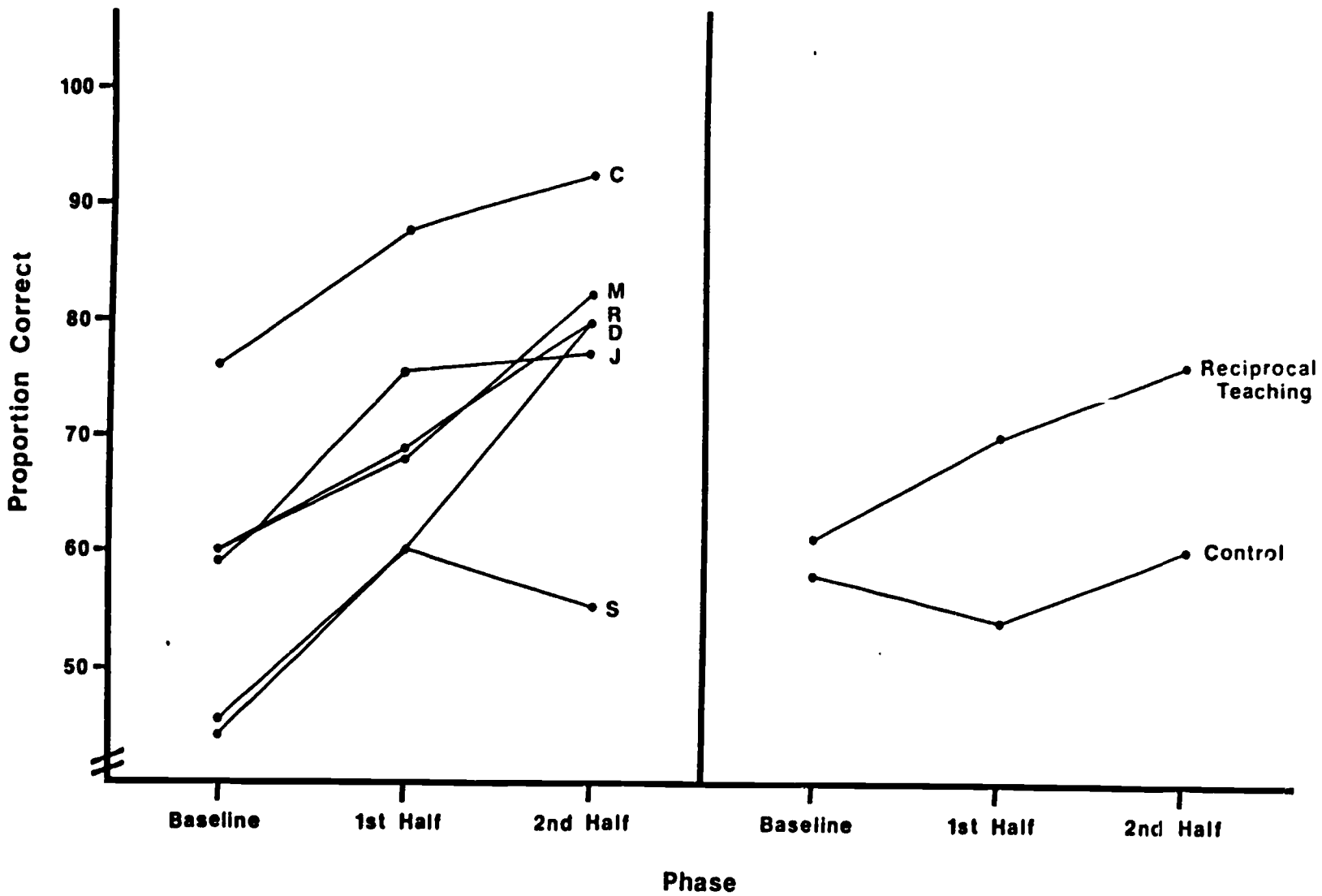
| | | Pretest | Posttest |
|---|---|---|---|
| Reciprocal Teaching: | Social Studies | 25 | 78 |
| | Science | 5 | 69 |
| Control Groups: | Social Studies | 13 | 11 |
| | Science | 20 | 18 |

3) Standardized Tests (Gates-McGinitie)

| | Comprehension | Vocabulary |
|---|---|---|
| Reciprocal Teaching: | +20 month | + 4 months |
| Control Groups: | + 1 month | + 3 months |

4) Laboratory Transfer

Significant transfers to novel tests of summarizing, questioning, and clarification.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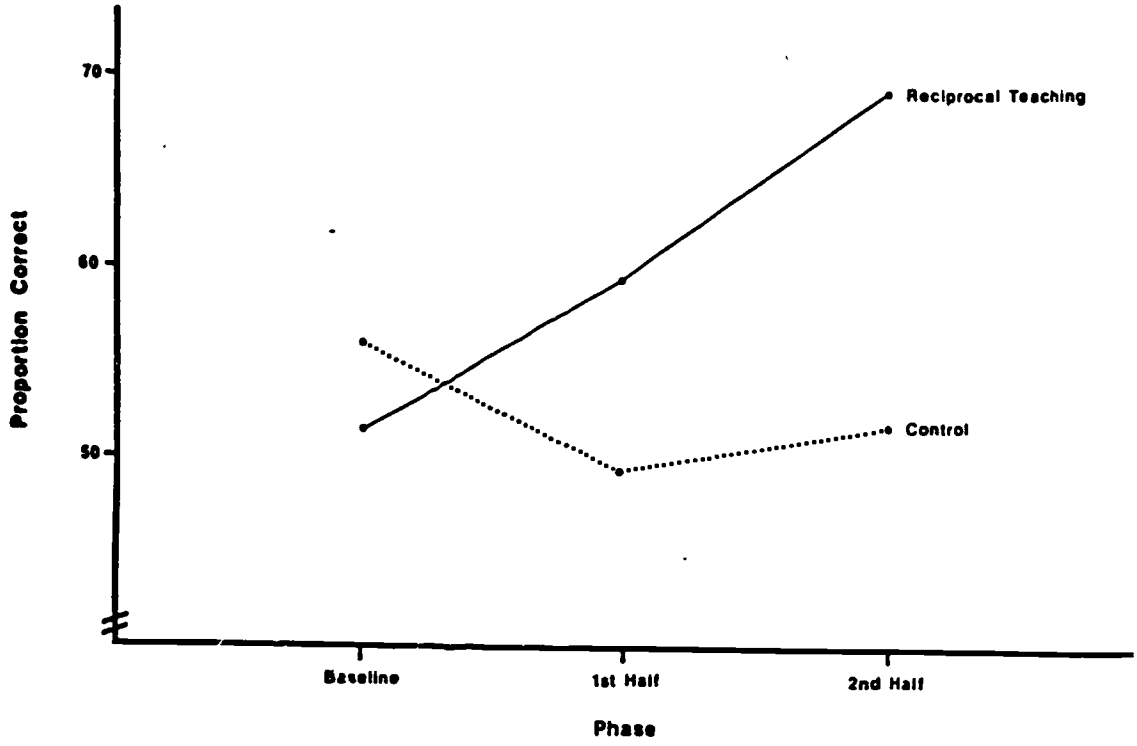
Proportion Correct
C
M
R
D
J
S
Reciprocal Teaching
Control
Baseline
1st Half
2nd Half
Baseline
1st Half
2nd Half
Phase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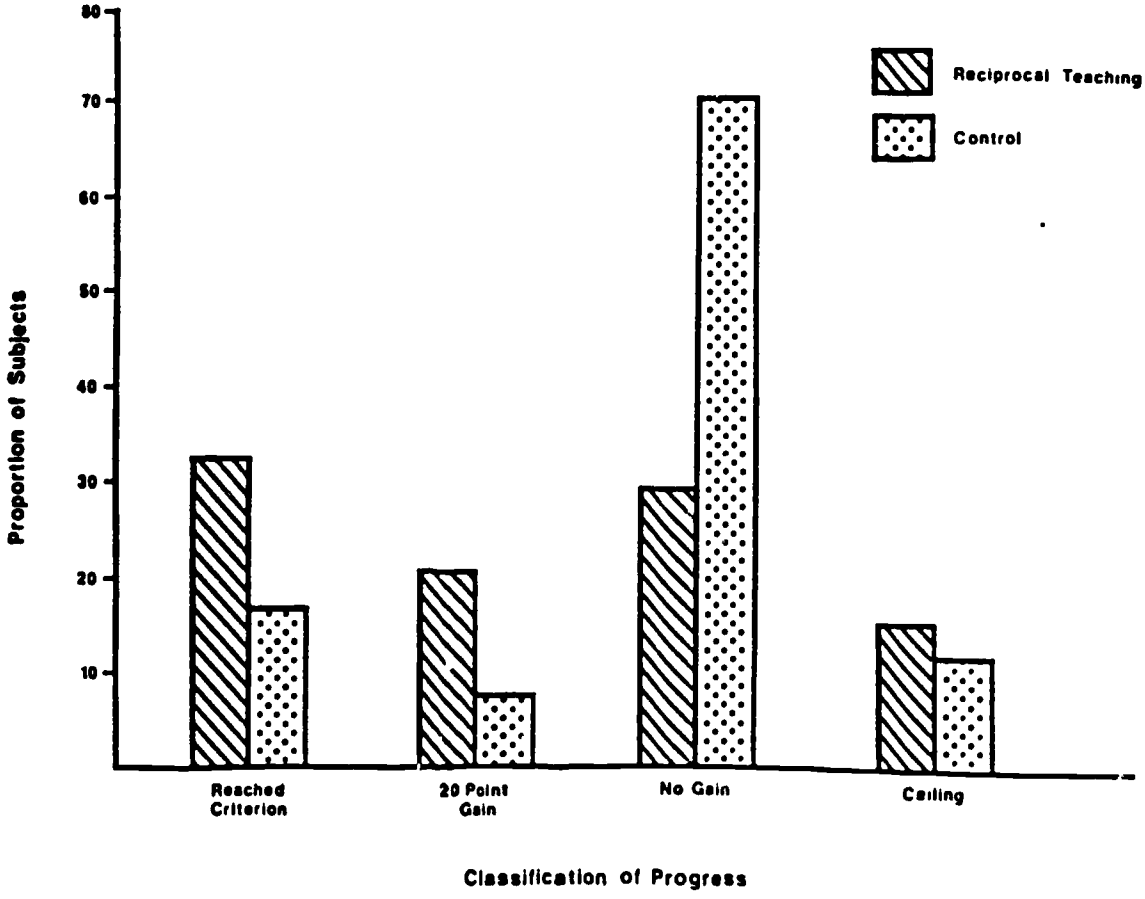
60
50
Proportion Correct
Reciprocal Teaching
Control
Baseline
1st Half
2nd Half
Phase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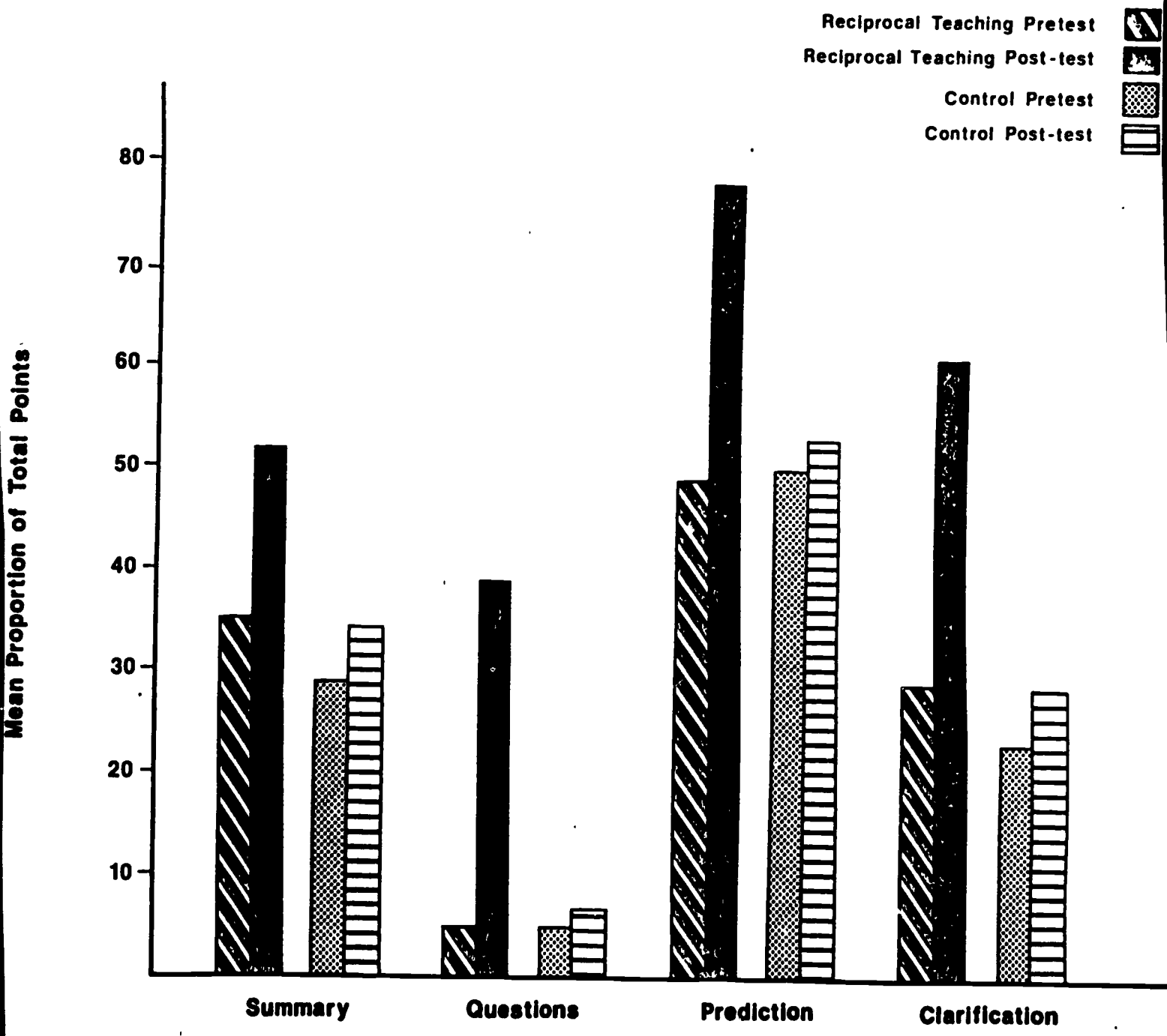
20
10
Proportion of Subjects
Reciprocal Teaching
Control
Reached Criterion
20 Point Gain
No Gain
Ceiling
Classification of Progress


Reciprocal Teaching Pretest
Reciprocal Teaching Post-test
Control Pretest
Control Post-test
Mean Proportion of Total Points
80
70
60
50
40
30
20
10
Summary
Questions
Prediction
Clarification