ARTICLES

Thinking and Speech and Protocol Analysis

Peter Smagorinsky

Department of Language Education
University of Georgia

Some form of verbal report—that is, a research participant's concurrent or retrospective verbal account of thought processes during problem-solving activities—has been used throughout this century as the database from which psychologists have developed theories of human mentation. Newell and Simon (1972) and Ericsson and Simon (1980, 1993) have provided extensive justification for using one such method, *protocol analysis*, as a tool for investigating cognition from an information-processing (IP) perspective. Their arguments have characterized protocol analysis as a methodology capable of providing evidence of the ways in which people attend to information stored in short-term memory to solve problems, with the evidence providing them with the grounds from which to generate models of human cognitive processes. A different view of protocol analysis is available from the perspective of cultural–historical activity theory (CHAT) based on the work of Vygotsky (1987), Leont'ev (1981), and others, and its concern with the mediation of human development by culturally and historically grounded signs and tools. Because of its emphasis on culturally channeled development, a CHAT perspective views speech, including the speech that serves as evidence for cognition in psychological research, as a tool that potentially enables changes in consciousness. In this article I outline a CHAT perspective that accounts for protocol analysis along three key dimensions: (a) the relation between thinking and speech from a representational standpoint, (b) the social role of speech in research methodology, and (c) the influence of speech on thinking during data collection. The purpose of this discussion is not to refute the IP perspective on protocol analysis but to illustrate how this method can be viewed through a CHAT lens and to identify alternative assumptions that must be made to use it from a CHAT perspective

Introspection has had a long and contentious history in psychological research. Its use as a method of inquiry dates at least to William James, who argued in 1890 that "introspective observation is what we have to rely on first and foremost and always" (p. 185). Research methods designed to study thought processes through the systematic elicitation and analysis of verbal accounts have been used by researchers in psychology and related fields throughout this century (e.g., Bereiter & Scardamalia, 1987; Bracewell & Breuleux, 1994; Claparede, 1934; Dansereau & Gregg, 1966; Duncker, 1926; Flanagan, 1954; Flower & Hayes, 1977; Hendrix, 1947; Ruger, 1910). Building

on this tradition, Newell and Simon (1972) developed *protocol analysis* as a systematic means of educing and analyzing a think-aloud account rendered by a person concurrent with solving a specific problem.[1] Protocol analysis has since been a staple of the methodological tool kit of researchers studying a variety of problem-solving activities, with virtually all following the theoretical principles of the information-processing (IP) theory that has motivated the work of Newell, Simon, Ericsson, and others.

IP theory is a branch of psychology that seeks to

> reveal in remarkable detail what information [people] are attending to while performing their tasks, and by revealing this information... provide an orderly picture of the exact way in which the tasks are being performed: the strategies employed, the inferences drawn from information, the accessing of memory by recognition. (Ericsson & Simon, 1993, p. 220)

IP's purpose thus lies in "developing and testing detailed information processing models of cognition, models that can often be formalized in computer programming languages and analyzed by computer simulation" (Ericsson & Simon, 1993, p. 220). Ericsson and Simon (1979, 1980, 1993) built a powerful case for the validity of protocol analysis as an investigative tool for developing the cognitive models that are the aim of IP research, providing abundant empirical evidence from IP studies in diverse fields in support of their argument.

Although generally associated with IP theory, protocol analysis has also served as a methodological tool for inquiries (e.g., Smagorinsky, 1997) grounded in cultural–historical activity theory (CHAT) based on the work of Vygotsky (1987), Leont'ev (1981), Wertsch (1981), Cole (1996), and others. This perspective approaches human cognition through assumptions that, in key areas, are fundamentally different from those that undergird IP theory. Unlike IP theory and its emphasis on creating models of problem-solving processes, a CHAT perspective is concerned with human development, particularly the role of cultural tools and signs in structuring and enabling changes in consciousness in socially channeled ways (Valsiner, in press; Wertsch, 1985, 1991). This social and developmental emphasis views speech as a cultural tool that produces meaning-laden linguistic signs. From this perspective studying one's speech during problem solving is less centered on inferring processes through an analysis of heeded information revealed through spoken words and more concerned with looking at both the ways in which speech serves a social and developmental purpose during engagement in task-related activity and the ways in which speech represents developmental changes across the lifespan.

In this article I outline both IP and CHAT perspectives as they pertain to the use of protocol analysis. I organize this analysis into three sections, each looking at the assumptions underlying the two perspectives according to a particular dimension. Because an IP view of protocol analysis has already been outlined in considerable detail by Ericsson and Simon (1993), I provide only brief summaries of their argument here and refer the reader to their text for a more comprehensive account of their view. The different assumptions underlying the two perspectives result in different conceptions of protocol analysis as a research methodology and different understandings of the import of the data that protocols elicit. Ultimately, protocol analysis may be used as a methodological tool by researchers from either theoretical orientation. Yet the different conceptions of the

---

[1] In this article I attend only to *concurrent* protocols. Ericsson and Simon (1978, 1980, 1984) also treated *retrospective* accounts of problem-solving processes in their defense of protocol methodologies.

relation between thinking and speech result in different ways of accounting for the data that emerge through the elicitation and production of a verbal protocol.

To avoid a possible theoretical confound, I must reiterate a fundamental difference between IP and CHAT accounts of cognition. The purpose of research conducted through an IP lens is to produce models of cognition, often with an emphasis on the kinds of processes associated with different degrees of expertise. From an IP perspective, the functional and developmental aspects of cognition are not of interest; rather, the focus is on performances that serve as evidence from which relatively static (i.e., not developmentally oriented) cognitive models may be built. From a CHAT perspective, development and learning are central concerns; thus, the focus is on how speech both represents and mediates changes in consciousness. Cole (1996) identified the following as the main characteristics of a cultural psychology:

It emphasizes mediated action in a context.
It insists on the importance of the "genetic method" understood broadly to include historical, ontogenetic, and microgenetic levels of analysis.
It seeks to ground its analysis in everyday life events.
It assumes that mind emerges in the *joint* mediated activity of people. Mind, then, is in an important sense, "co-constructed" and distributed.
It assumes that individuals are active agents in their own development but do not act in settings entirely of their own choosing.
It rejects cause–effect, stimulus–response, explanatory science in favor of a science that emphasizes the emergent nature of mind in activity and that acknowledges a central role for interpretation in its explanatory framework.
It draws upon methodologies from the humanities as well as from the social and biological sciences. (p. 104)

Wertsch (1985) further pointed out that the term *activity* refers to

a social institutionally defined setting [in which] the implicit assumptions ... determine the selection of actions and their operational composition. The guiding and integrating force of these assumptions is what Leont'ev called the motive of an activity. For Leont'ev a motive is not a construct that can be understood in biological or even psychological terms. Rather, it is an aspect of a sociohistorically specific, institutionally defined setting. Among other things, the motive that is involved in a particular activity setting specifies what is to be maximized in that setting. By maximizing one goal, one set of behaviors, and the like over others, the motive also determines what will be given up if need be to accomplish something else. (p. 212)

Activity, then, is commensurate with activity *settings* and thus is essentially tied to social contexts. Wertsch stressed that activity settings, although constrained by the physical context in which they occur, are not determined by the physical contexts but rather are constructed by the people who inhabit them. To Wertsch, analyzing the social institutional settings in which *interp*sychological functioning occurs enables the study of *intra*psychological functioning. These three levels of analysis—social institutional, interpsychological, and intrapsychological—are necessarily linked and enable the study of the relation between activity settings and the individual, a fundamental goal of a Vygotskian approach (Wertsch, 1985, p. 216). Wertsch (1981) reduced a Vygotskian approach to activity to the following principles: "the notion of *internalization* is concerned with the *ontogenesis* of the ability to carry out *socially formulated, goal-directed* actions with the help of *mediating devices*" (p. 32).

This emphasis on the socially situated, mediational role of speech and other cultural tools and its involvement in ontogenesis provides CHAT researchers with a project that is distinct from that of IP's concern with developing generalizable models of cognition (R. J. Bracewell, personal communication, February 7, 1997). From a CHAT perspective, models of cognition cannot be generalizable because different cultures formulate different goals, thus causing mediating devices (e.g., psychological tools such as speech) to function differently from culture to culture, resulting in the internalization of different ways of thinking (Tulviste, 1991).

Before beginning my analysis I must acknowledge the notorious difficulty researchers have had making their cases both for and against protocol analysis as a reliable and valid means of investigating psychological processes. Psychologists will, after all, probably never really know exactly what goes on inside people's heads, a problem that has resulted in (a) psychologies predicated on the study of behaviors and outcomes (e.g., Skinner, 1957), rather than efforts to investigate the cognitive processes that produce them, and (b) historical skepticism about methods of investigation that rely on introspection and self-reports of thinking processes (e.g., Lashley, 1923; Nisbett & Wilson, 1977). Those theories that do attempt to account for cognitive processes, including both IP and CHAT, are based on data-driven inferences rather than empirical proof, due to (a) limitations in studying the functions of the human mind that remain unobservable, and (b) for CHAT researchers, continued uncertainty regarding both the location and constitution of the mind and the extent of its boundaries (Salomon, 1993; Smagorinsky, 1995; Wertsch, 1991).

The validity of protocol analysis has been studied by IP researchers primarily through outcome measures, typically provided by contrasts between groups of people solving problems silently and groups solving the same problems while verbalizing their processes. In a typical such study (Feldman, 1959), one participant predicted the outcome of a binary choice problem and concurrently tried to verbalize his thought processes, whereas two large control groups solved the same problem silently, with no differences found in the types of choices or number of correct predictions. From studies such as this one, Ericsson and Simon (1980, 1993) inferred that, while slowing the problem-solving processes, the think-aloud condition does not alter them.

Compounding the problem of the need to infer cognitive processes from public performance is the lack of sufficient specific research on protocol methodologies. Stratman and Hamp-Lyons (1994) pointed out that "the comprehensive theory developed by Ericsson and Simon (1984), to predict when concurrent [think-aloud] protocols will interfere with subjects' processes, is actually based on few direct studies of reactivity" (p. 109; cf. Russo, Johnson, & Stephens, 1989). Most of the studies reviewed by Ericsson and Simon are not studies of the methodology itself but studies that attempt to use the methodology to study some specific problem-solving processes. Their conclusion that thinking aloud does not alter thought processes is thus an inference drawn from studies that, for the most part, are not designed to investigate the method itself.

My effort to describe a CHAT perspective on protocol analysis is considerably more problematic, given the fact that protocol studies grounded in CHAT are rare. The theory's primary architect, Vygotsky, himself never used the method in his research. His attention to think-aloud data comes in his account of egocentric speech, which he does not analyze through the sort of systematic collection and analytic procedures enabled since his death by the technology of tape recorders. For the most part Vygotsky studied social interactions, an approach that CHAT researchers have come to regard as the best available way to study the hidden psychological processes of individuals. In the proto-CHAT research method best approximating protocol analysis, Vygotsky's collaborator Luria (1932) used the *combined motor method* in which he created "a scripted situation where a

subject had simultaneously to carry out a motor response (squeeze a bulb) and a verbal response (give the first word that comes to mind) when presented with a stimulus word" (Cole, 1996, p. 280; cf. Cole, 1979). To Luria these visible responses allowed for inferences about hidden psychological processes. Although sharing IP's assumption that an utterance can serve as the basis for understanding mentation, Luria took a more social view of the data, choosing to study consciousness in a state of experimentally manipulated social *disruption* rather than during experimentally controlled, presumably unadulterated functioning as IP studies claim to do. Luria's assumption that human beings must be explained by phenomena in the world outside themselves has been taken as axiomatic by CHAT researchers. Newman, Griffin, and Cole (1989), for instance, described their effort to study internalized processes through the social interactions that precede them:

> There are processes which must properly be characterized as interpsychological—arising from the interaction between people—which play a major role in producing cognitive changes. These interactive processes are accessible to observation and can provide an important link to explain cognitive change. (pp. 92–93)

Perhaps one reason that protocol analysis has rarely been used in CHAT studies is because of IP's belief in creating asocial experimental settings. I intend to argue in this article that a concurrent verbal protocol has the *appearance* of being a solitary act, yet from a CHAT perspective can only be understood as a social act.

This argument is based on inferences, as is that of Ericsson and Simon (1993). My attempt is therefore to provide two different theory-driven accounts of protocol analysis, each of which rests on a suppositional foundation inferred from observable behavior. The primary sources I draw in making my argument are Ericsson and Simon's (1979, 1980, 1993) accounts of IP and Vygotsky's (1987) *Thinking and Speech*. I choose these sources as the primary exponents of fields of thought that themselves are unified around general principles but include differences and variations in assumptions and methods. I feature Ericsson and Simon because, of the IP theorists, they have devoted by far the most attention to protocol analysis. I choose Vygotsky because *Thinking and Speech* is the foundational work in subsequent efforts to understand the relation between thinking and speech in CHAT accounts of mentation. His view of development has been critiqued and revised since his death, and those revisions are included in the account of CHAT that I use to reconsider protocol analysis.

The two theoretical lenses featured in this article rest on different assumptions and are supported by substantially different types of evidence. In one sense, Ericsson and Simon made their case with far greater breadth and detail, drawing on hundreds of studies to support their contention that protocol analysis both represents an IP perspective and serves to document the validity of IP assumptions. Vygotsky's view, in contrast, is in many ways a case still under construction. Indeed, on the issue of the influence of speech on thinking, Ackerman (1993) argued forcefully that studies supporting "writing to learn" pedagogies, which correspond to Vygotsky's idea that speech can serve as a developmental tool, are insufficiently robust and persuasive to support their rather grand claims for the transformational effects of writing on writers' thinking. Any consideration of Ericsson and Simon's views on cognition should acknowledge that it would be difficult to produce a more detailed, empirically supported, intellectually responsible argument than they provided in *Protocol Analysis: Verbal Reports as Data* (1984/1993), and any effort to provide a CHAT alternative should acknowledge the difficulty of demonstrating how speech-related activities serve

development. At the same time, one should also recognize that IP's intimate relation with protocol analysis as a methodological tool provides Ericsson and Simon with a greater body of work to draw on in supporting their view and that CHAT claims are rarely tested with the sorts of experimental designs that provide Ericsson and Simon with such overwhelming evidence in support of their argument. Furthermore, protocol analysis has rarely been used in CHAT-motivated studies. As a result, the empirical database in support of the CHAT view of protocol analysis is limited.

My effort is not to try to win the argument for the CHAT perspective, but to contrast the two perspectives on major issues in understanding the relation between thinking and speech and to examine the implications for research in accepting the different assumptions they make about the role of speech in representing and changing one's thinking. My own history with this problem is perhaps revealing. My graduate training emphasized IP approaches to theory and methodology, and this orientation was reflected in my first research efforts using protocol analysis (Smagorinsky, 1989, 1991, 1994). For various reasons I became interested in cultural issues that channel cognition and began a series of methodological ruminations (Smagorinsky, 1995, 1997; Smagorinsky & Coppock, 1994, 1995a, 1995b) that considered, among other questions, What is it that we study when we study what people say? How does the theoretical lens that we bring to this question affect the ways in which we both collect and attribute meaning to data? These questions form the basis for the inquiry that follows.

I next outline IP and CHAT perspectives according to three dimensions: (a) the relation between thinking and speech from a representational standpoint, (b) the social role of speech in research methodology, and (c) the influence of speech on thinking during data collection. Through these considerations I develop assumptions that undergird the use of protocol analysis from a CHAT perspective.

THINKING AND SPEECH AND REPRESENTATION

The data elicited from a think-aloud protocol get rendered in the form of a transcription that then gets subjected to some form of systematic analysis, usually through the application of a coding system. How one approaches this analysis depends on what one sees as the purpose of psychological research and how its conduct follows from that purpose.

If researchers view transcribed verbal reports as symbols that reveal something about thinking, then they need to have a theory that accounts for the relation between thinking and speech. Among these theoretical concerns should be an account of the manner in which speech (the set of verbal artifacts that constitute the protocol) represents thinking. IP approaches to cognition use a computer model to account for the ways in which people process, store, and retrieve information. The goal of IP researchers is to build models of cognitive processes that are both based on verbal reports and in turn would predict the unfolding of verbal reports (Ericsson & Simon, 1980, 1993). A well-conducted protocol can, from an IP perspective, "guarantee a close correspondence between the verbal protocol and the actual processes used to perform the task" (Ericsson & Simon, 1993, p. xv).

The characterization of protocol analysis as a verbal *report*, the term used by Ericsson and Simon (1978, 1979, 1980, 1984) throughout their extensive consideration of the topic, suggests that what is verbalized is a reasonably accurate account of something interior. As Ericsson and

Simon (1980) described it, "With the instruction to verbalize, a direct trace is obtained of the heeded information, and hence, an indirect one of the internal stages of the cognitive process" (p. 220). They continue

> Within the context of this general model, verbalization processes produce (externalize) information that is in STM [short-term memory]. In the case of thinking-aloud instructions, the information verbalized will then be some portion of the information currently being attended to ... making a verbal report requires, according to this model, the corresponding verbal representations of the information ... to be evoked. (pp. 225–226)

Thinking aloud, they concluded, "will not change the structure and course of the task processes, although it may slightly decrease the speed of task performance" (p. 226). Verbalizations, they said,

> involve either direct articulation of information stored in a language (verbal) code (Level 1 verbalization); articulation or verbal recoding of nonpropositional information without additional processing (Level 2 verbalization); or articulation after scanning, filtering, inference, or generative processes have modified the information available (Level 3 verbalization). (p. 227)

A key part of Ericsson and Simon's (1993) argument is that their model of human IP is predicated on their ability to identify information heeded in STM. From the report of information heeded, the researcher can apply codes that then lead to inferences about problem-solving processes. They distinguish their own notion of the proper conduct of protocols from the notions of others:

> Many procedures attempt to encode the *processes* that generate heeded information, rather than the heeded information itself. But the processes can only be implied from the information in STM, which does not, as we have seen, usually include information about process. (p. 258)

Given the goal of IP theory to develop models of problem-solving processes, an utterance serves as a trace, a source of evidence, through which to infer the inner workings of the mind. One frequent application of protocol analysis in IP studies is to develop expert–novice contrasts in problem-solving processes. Understanding processes that take place at different points in development is therefore a component of their project. Analyzing the means through which development takes place, however, is not central to their purposes.

CHAT perspectives, in contrast, endeavor to understand the means through which cognition develops, in terms of both cultural history and the individuals who are situated in specific (although usually overlapping) social, cultural, and historical contexts. From this perspective, problem solving is a function of both how problems are defined in circumscribed milieus and how people have historically solved those problems with particular cultural goals in mind. Problem solving is thus a situated practice that is not generalizable across cultures, and so expert–novice studies would yield different processes if conducted as cross-cultural studies where the cultural values, goals, practices, tools, and signs have historically developed to achieve different ends.

From a CHAT perspective words are the most significant cultural artifacts through which to study and understand cognition, embodying both the individual's personal development and the aggregate meaning of a group's cultural development. In Vygotsky's (1987) view of the relation between thinking and speech, the study of speech is the study of cultural history. Yaroshevsky

(1989) pointed out that Vygotsky viewed "the word as a concretism of cultural senses" (p. 80) and believed that "methodology without history is empty" (p. 173). Human consciousness, in this conception, is not the isolated functioning of a single mind, but a social mind whose structure and function are predicated on the ways in which a person has learned to use cultural tools. Words are both immediately social and historically cultural, said Vygotsky: "In consciousness, the word is what—in Feuerbach's words—is absolutely impossible for one person but possible for two. The word is the most direct manifestation of the historical nature of human consciousness" (p. 285). To Vygotsky the task of psychology "is not the discovery of the eternal child. The task of psychology is the discovery of the historical child, of what Goethe called the transitory child. The stone that the builders have disdained must become the foundational stone" (p. 91).

This historical setting provides the context for the development of concepts by individual members of a culture. With Vygotsky's genetic (developmental) orientation, words serve as signs that represent concept development. To Vygotsky (1987), words reveal the whole state of human consciousness:

> Consciousness is reflected in the word like the sun is reflected in a droplet of water. The word is a microcosm of consciousness, related to consciousness like a living cell is related to an organism, like an atom is related to the cosmos. The meaningful word is a microcosm of human consciousness. (p. 285)

In *Thinking and Speech* he outlined how word meaning indicates the degree to which people grow toward what he called scientific concepts, which are formally learned through systematic instruction and which include a multiplicity of members that are unified by a single theme. He distinguished scientific concepts from complexes, which are generalizations learned through practical activity and everyday social interaction and which encompass a group of items in which individual members are linked according to shared properties, though not all are linked according to the same property. To Vygotsky, word meaning is the appropriate unit of analysis for studying cognitive development because through the meanings that people attribute to words, psychologists can understand the degrees of abstraction that they have achieved in their thinking. The word or sign is fundamental to the process of concept formation and development. For a method to account for word meaning, it needs to account for "the material on the basis of which the concept is worked out and the word through which it arises" (p. 122). In other words, a method needs to view artifacts, including words, as representative of cultural history and of the mediational means through which world views are represented and internalized.

CHAT researchers also need to understand how words function for individuals. When people attribute meaning to words, they do so for internally regulatory purposes and communicative purposes (Lee, 1985). Linguistic artifacts such as words are fundamentally communicative—that is, they provide signs that have a meaning potential that is then interpreted by others according to their own culturally learned ways of imputing significance to artifacts. Linguistic signs enable people to communicate with one another (assuming that they attribute reasonably similar understandings to the same words) and to regulate their own behavior. Vygotsky's (1987) attention to the representational capacity of speech was therefore concerned with *meaning*, both in terms of the meanings that people communicate through language and the development of their own ability to think about meaning in rational, abstract, systematic ways, and consequently as a way to think of, impose order on, and exercise control over the world (Wertsch, in press). Understanding an

utterance, then, involves understanding the web of meanings within which it is voiced and understanding the larger social goals that suggest the motivation for and teleological assumptions behind the development of personal goals. Vygotsky (1987) argued that "the development of logical thought is nothing but a reflection of the historical process in an abstracted and theoretically consistent form. ... Historical analysis becomes the key to the logical understanding of concepts" (p. 147). With the variance of cultural–historical traditions across both societies and idiocultures, historical analysis must be highly localized to understand concept development.

To achieve this understanding, one needs to identify and account for the environmentally channeled task and trajectory of an action. This premise implies that interpreting a protocol requires knowledge of the participant's cultural history, the researcher's goal-directed behavior within the conduct of the study, and the degree to which their congruence allows for words-as-signs to be assigned similar meanings by the two of them. In using a CHAT perspective to understand protocol analysis, it is important to understand the historical processes of both the participant and the researcher to understand how both construct the task and why they construct it as they do. Vygotsky's (1987) view of training sessions prior to data collection was revealing on this point. He viewed training sessions as among the most critical areas of study, for that is where researchers can

> study how the subject uses the sign as a means of directing his intellectual operations. Depending on how the word is used, depending on its functional application, we are able to study how the process of concept formation proceeds and develops. (p. 128)

This view differs from that of IP researchers (as well as researchers from most other clinical branches of psychology), who train their participants in the task prior to data collection to familiarize them with the procedures (e.g., Flower and Hayes's, 1980, use of a jug filling problem to allow participants to practice solving problems while thinking aloud, prior to collecting a protocol of their concurrent thinking aloud and writing). From a CHAT perspective, task construal is significant because it reveals the participant's level of concept development and interpretation of signs; the training period, then, is not so much practice as a key developmental point during which researcher and participant move toward intersubjectivity. To Vygotsky this period is of greater theoretical interest than the developmentally advanced performance that follows.

From a CHAT perspective, then, it is critical to consider a verbal report as not only a trace of a problem-solving process, but to understand

1. How the researcher and participant construe the task, how the participant's task construal develops during the course of the research, and which aspects of the activity setting help to account for this development.
2. How their relative senses of task construal provide each with an anticipated trajectory for completing the task.
3. How their relative senses of trajectory have been culturally mediated in their personal histories.
4. How their respective personal histories have been culturally situated and channeled.
5. How the participant's rendering of linguistic signs indicates both the path and level of concept development.
6. How the researcher's own conceptual path for interpreting those linguistic signs has been culturally channeled.

THE SOCIAL ROLE OF SPEECH IN RESEARCH

The factors of cultural mediation and communication outlined in the previous section have immediate as well as historical implications for conducting protocol analysis from a CHAT perspective. Researchers have long been concerned with various problems with *reactivity*, which is the way in which a method of investigation affects the phenomena being studied. Researchers, for instance, can help shape results by anticipating preferred outcomes and subtly providing conditions that favor their development. IP and CHAT researchers both recognize the likelihood of introducing confounds in research that involves researcher–participant interaction. Both theoretically and methodologically, however, they view the problem differently.

Ericsson and Simon (1980) recognized the ways in which a protocol may be influenced by contextual factors. They pointed out, for instance, that

> various kinds of intermediate processes may intervene between the internal representation of information and its verbalization. ... [The] circumstances under which verbalization takes place can have a significant effect on what is verbalized and on the interpretation of the verbal data. (p. 218)

Their primary concern is that the type of instructions provided by researchers can cue particular reports from participants; in IP parlance, these cues direct the retrieval of specific bits of information from STM. Ericsson and Simon (1993)

> found substantial evidence that differences in performance were induced by *telling* the subject *how* to verbalize. To verbalize the information called for by the instructions, instead of the information he would normally have attended to, he had to change his thought processes. (p. 107)

They were critical of protocol instructions that cue specific responses, saying that "many verbalization procedures referred to as 'think aloud' include elements that, from our point of view, would influence the sequence of thoughts" (Ericsson & Simon, 1993, p. xxxi). In their view, then, the verbal report is an account of cognitive processes that are specifically cued by the data collection procedures, and the model that is generated from the report must take into account the type of information solicited for retrieval from STM. Ideally, however, the cues provided in the elicitation procedures provide as little specific direction as possible. As presented in Hayes and Flower's (1983) model, the researcher is part of a *task environment*, and the cue provided by the researcher is a trigger for an internal retrieval process that is then reported verbally.

Ideally, the role of the IP researcher is neutralized to the greatest extent possible, through both the content of the instructions and the physical presence of the researcher. Ericsson and Simon (1993) emphasized that a protocol should not be elicited as an act of communication; they recommended that in setting up a protocol, "the experimental situation is arranged to make clear that social interaction is not intended, and the experimenter is seated behind the subject and hence is not visible. ... The social interaction between subject and experimenter is minimized" (p. xiv). Prompts by the researcher to the research participant should be along the lines of "'Keep talking' because it is the least directive and does not require any direct answer to the experimenter" (p. 256). In Ericsson and Simon's view, the social processes involved in protocol collection should be minimized to the greatest extent possible to allow for the most unadulterated view of cognitive processes.

The alternative view I propose through an CHAT lens is based on Vygotsky's view of egocentric speech modified by (a) Cole's (1992, 1996) critique of Vygotsky's (1987) insufficiently cultural

view of the first 2 years of development and (b) Bakhtin's (1984) notions of *addressivity* and *hidden dialogicality*. Through this review I make the case that all speech is social, and through this argument I propose that from a CHAT perspective it is possible to change but not minimize the social role of speech in protocol-based research.

Vygotsky (1987) noted what he believed to be the similarities between Watson's use of think-aloud methodologies and children's egocentric speech. In Vygotsky's view the verbalization of Watson's participants was similar to the egocentric speech of young children:

> One need only consider psychological experiments such as those carried out by Watson where the individual is asked to solve some intellectual task while verbalizing and displaying his inner speech to see the profound similarity between the adult's overt verbal thinking and the child's egocentric speech. (p. 72; see Watson, 1920)

Egocentric speech and think-aloud verbalizations, he said, are similar in that "both are speech for oneself" (p. 71), serving a function that is regulatory and expressive. To the degree that they occur in social settings, they are also both social, thus reflecting a conflation of language functions.

Cole's (1992, 1996) critique of Vygotsky comes through his disagreement with Vygotsky's view that biological and cultural lines of development have separate origins that converge at about the age of 2. Cole draws on the concept of *prolepsis*—the culturally mediated projection of a social future to a present situation—to argue that *"one cannot say that first comes the phylogenetic part and then comes the cultural part and the individual part. All are there from the outset"* (p. 214). His conclusions are based on research on infants that consistently points to the cultural fact that parents and other adults project a probable future for children and structure their environments to eventuate that future. In one study, for instance, Rubin, Provenzano, and Luria (1974) found that newborns were treated in a physical way if wearing blue diapers, but more with sweetness when wearing pink. Thus, social futures are anticipated and facilitated from the earliest days of life, prompting Cole to conclude that children "come bathed in the concepts their community holds about babies just as surely as they come bathed in amniotic fluid" (p. 184). From this perspective, egocentric speech is a culturally grounded act. At the most obvious level the child is speaking a specific, learned language and using it according to local values and customs. The child's utterance is thus dialogic in Bakhtin's (1981) sense: It achieves meaning as part of a greater whole in which there is constant interaction between meanings. Holquist (1981) ascribed to Bakhtin the notion of a "dialogic imperative, mandated by the pre-existence of the language world relative to any of its current inhabitants, [that] insures that there can be no actual monologue" (p. 426). In this sense, then, even apparently egocentric speech has a social basis and is uttered in ways that imply a link to other people. Bakhtin was not a child psychologist and did not study the early speech of young children. But his dialogic imperative supports Cole's argument that culture—and thus historically grounded, meaning laden, communicative, and regulatory artifacts such as speech—influences development from the beginning of social life.

Bakhtin's (1986) notion of dialogism leads him to argue that

> addressivity, the quality of turning to someone, is a constitutive feature of the utterance; without it the utterance does not and cannot exist. The various typical forms this addressivity assumes and the various concepts of the addressee are constitutive, definitive features of various speech genres. (p. 99)

In this view an utterance is not self-sufficient but is a link in a genre-based communicative chain, thus arising from prior utterance and likely evoking further utterance. The addressee need not be immediately present but might be distant, and might further be an indefinite other rather than a specific person. Wertsch (1991) pointed out that

> Ultimately, an utterance reflects not only the voice producing it but also the voices to which it is addressed. In the formulation of an utterance a voice responds in some way to previous utterances and anticipates the responses of other, succeeding ones; when it is understood, an utterance comes into contact with the "counter word" of those who hear it.
>
> Bakhtin's concern with addressivity in the utterance thus involves both a concern with *who is doing the speaking*—the fact that "the utterance has ... an author" (1986, p. 95)—and a concern with *who is being addressed*. Because any utterance entails the idea of addressivity, utterances are inherently associated with at least two voices. (p. 53)

Wertsch tied Bakhtin's idea of addressivity to the notion of *voice*, a term that suggests that even apparently isolated articulations by an individual have a communicative basis. Wertsch argued that a goal of psychology therefore is to account for human mentation through a recognition of the relation between mental processes and their cultural, historical, and institutional settings, which are socially constructed and provide the activity setting that motivates and reciprocates individual mental functioning and communicative utterance.

Bakhtin (1984) further argued that, because utterance is inherently social, speech can participate in a relation that he referred to as "hidden dialogicality":

> Imagine a dialogue of two persons in which the statements of the second speaker are omitted, but in such a way that the general sense is not at all violated. The second speaker is present invisibly, his words are not there, but deep traces left by these words have a determining influence on all the present and visible words of the first speaker. We sense that this is a conversation, although only one person is speaking, and it is a conversation of the most intense kind, for each present, uttered word responds and reacts with its every fiber to the invisible speaker, points to something outside itself, beyond its own limits, to the unspoken words of another person. (p. 197)

Taken together, Cole's (1996) view of the intermingling of cultural and biological development and Bakhtin's (1981, 1984, 1986) notions of addressivity and hidden dialogicality suggest that egocentric speech and think-aloud methodologies are both part of a hidden dialogue. To illustrate this point I draw on a case study I conducted on the writing of a high school senior named Doug (Smagorinsky, 1997). The protocol collection was different from that of most studies. Doug was issued a portable cassette recorder that he kept for 4 months. He was asked to provide protocols for his writing whenever he found it convenient and for whatever writing he did either for classes or for other reasons. Doug's situated use of the protocol brought out its social nature and hidden dialogicality. Although he and I rarely had personal contact, he frequently addressed me (or, at least, his conception of me) as he talked into his tape recorder while writing. At one point, for instance, his protocol included the following statement:

> I would like to take the chance to thank you for letting me do this because it is kind of neat to get my thoughts out ... It is kind of neat to have someone to talk to like this. And after I am done with the experiment, I will keep doing this, I will keep talking in the recorder. Leave

some sort of physical memory behind of me, but other than that it helps to get my voice out. It is something that I can't always talk about to other people.

Here Doug explicates the way in which a hidden dialogue can take place between participant and researcher. This statement and others in the protocol reveal that Doug was not simply providing a protocol, he was providing it *to* someone. Few of his statements were so explicit. Yet the addressivity of his protocol is evident in his routine statements directed to his listener. For instance, at one point he explained the dramatic structure of a story he had written that involved heightened anticipation followed by sudden disappointment. He then described a television program he had seen that had provided the dramatic structure he sought to adopt:

I don't know if you have ever seen the Saturday Night Live, Steve Martin plays a midget, well you don't know that. He and this lady are at a table eating and they are describing each other to themselves and as they say something that the other person finds attractive or a plus in their personality you hear this whistle go up like—I can't whistle, I am sorry ...

Again, he explicitly addresses his listener, revealing that his account of process is a function of his conception of his listener: He assumes that the listener does not share the same viewing habits and therefore caters his explanation to meet his listener's presumed needs. Interestingly enough, Doug said on several occasions during interviews that he was a private person who did not reveal himself often, especially to people he felt close to (and therefore vulnerable with), but would do so with trusted "third party" listeners who would not use his confessions against him. In a follow-up interview Doug stated that our personal distance allowed him to reveal himself in unusually intimate ways, allowing his protocol to include the emotional turmoil behind much of his writing. Presumably, a different listenership—another teenage boy, for instance—would have elicited a different protocol.

That think-aloud protocols can potentially be influenced by the characteristics of a researcher is not a new observation. Rosenthal (1966) catalogued the seemingly endless number of interpersonal effects between researcher and participant that can affect the emergence of data, including effects based on gender, race, perceived ethnicity, researcher biases and hypotheses, and other factors. Rosenthal studied interaction effects between researchers and participants in face-to-face encounters. Ericsson and Simon (1993) were aware of these effects and tried to design data collection procedures to minimize or even neutralize them. In my understanding of a CHAT perspective, the goal should not be so much to neutralize these effects but to assume that they exist and then to identify and account for them in the data collection and analysis. Placing the researcher behind the participant, for instance, might prove to be a disconcerting experience for some participants in conjunction with some researchers. The result might not be a neutralized mediator, but a mediator that facilitates a hidden dialogue characterized by uncertainty, suspicion, or other feeling that could influence the shape of the data. From a CHAT perspective the goal would be to explicate the intersubjectivity between researcher and participant in the greatest detail possible. In particular, it would be important to understand how and why the participant constructs an interpretation of the situation in the way he or she does to understand why this particular account is rendered in this particular context. Protocol research conducted from a CHAT perspective would then need to take into account:

1. Both the researcher's and participant's sense of prolepsis for (a) themselves, (b) one another, (c) the setting, and (d) the task, and how those anticipated futures channel the performance of both.

2. The relation between participant and researcher and how the participant's conception of the researcher provides the speech genre invoked, the content reported, the trust accorded to the listener, the rules for what it is appropriate to say, the emotion involved in the report, and other factors of interpersonal communication.

3. Other contextual factors that might influence the participant's construction of meaning for the situation and resultant form of address.

THE INFLUENCE OF SPEAKING ON THINKING

My final area of consideration concerns IP's and CHAT's way of theoretically accounting for a different type of reactivity: the role of the act of speaking on the thought processes being studied through the procedure of thinking aloud. I have already reviewed the way in which a CHAT perspective would assume that thinking aloud shapes thinking by providing it with a specific addressee. In this section I review other aspects of this problem. First, however, I briefly review the way in which IP researchers have accounted for the influence of speaking on thinking during data collection.

Stratman and Hamp-Lyons (1994) posed the problem from an IP perspective by asking, "Do subjects' verbalizations of thoughts during a task actually alter the cognitive processes required to carry out the task—in ways that either enhance or obstruct the cognitive processes subjects would use when not under the [think-aloud] condition?" (p. 89). The question of reactivity is of concern in IP-based studies because, if the process of providing a protocol changes the participant's thought processes, then a confound is likely in interpreting the data. Ericsson and Simon (1979) argued that extensive testing reveals that "verbalization will not interfere with ongoing processes if the information stored in STM is encoded orally" (p. 16). Ericsson and Simon (1993) said that the process of verbalization has differential effects depending on the characteristics of the tasks being conducted and the instructions to verbalize "when the instructional procedures conformed to our notion of Level 1 or Level 2 verbalization, the studies gave no evidence that verbalization changes the course or structure of the thought processes" (p. 106).

Some cognitive theorists have pointed out the ways in which acts of composing result in the development of new ideas during ill-structured tasks in which "the problem itself is not usually fully defined beforehand. ... Rather, the process of problem definition is in part carried out through the activity of text production as the writer organizes, reorganizes, and elaborates knowledge in the course of writing" (Bracewell & Breuleux, 1994, p. 56). Bracewell and Breuleux are attentive to the ways in which a cognitive model can account for changes in problem definition and, by implication, changes in consciousness. Other IP theorists have found such changes to have deeper roots than are apparent from limited observation. Ericsson and Simon (1980) addressed the issue of sudden insights developed while engaged in problem solving, a phenomenon that might undermine a conception of cognition grounded in the view that cognition is a function of memory retrieval. An insight, they argued, is not a new discovery but, as Durkin (1937) argued, "can always be found to have developed gradually. The suddenness must be regarded as due to the concealment of the background. It does not bring in a *new* kind of process" (p. 81; cited in Ericsson & Simon, p. 238). In this view, what appears to be a sudden insight is really the retrieval of prior knowledge that is brought to bear on a new problem. For Ericsson and Simon, then, apparent changes in

consciousness are accountable for within IP theory, being reorganizations of information from memory into new schemata.

The different projects of IP and CHAT result in contrasting views of the role of speaking relative to the process of thinking. From an IP perspective, the goal of research is to use verbal reports to generate models of cognitive processes. If they are to achieve this goal, they must regard mediating influences as potential sources of adulteration to the processes they are trying to infer and thus try to minimize them during data collection or account for them theoretically. Tangible mediators such as researchers and their prompts are identifiable and controllable through careful, theoretically informed data collection procedures. A factor such as speech is accounted for through a theoretical assumption that it does not serve a mediating function but instead reveals the kind of information being heeded in STM.

From a CHAT perspective the goal of research is to understand development as it is culturally mediated. If they are to achieve this goal, they must identify and understand the ways in which cultural mediators channel cognitive change. A CHAT researcher assumes that speech is among the cultural tools that serve this mediating function. The mediated nature of consciousness is an assumption from which their work proceeds. From a CHAT perspective, then, the goal is to understand the ways in which the tool of speech mediates the thinking that is studied through the collection of a protocol. From this perspective the term *think aloud* is incomplete. More accurately, the procedure describes a *think-and-mediate-aloud* data collection through which what is revealed is not only an internal process, but a process that reflects the cultural practices that are internalized through participation in speech-based interactions and which in turn act on their social context through speech-based interactions. As Cole (1996) noted, schemata are not simply internal cognitive structures but representatives of and participants in social practices (pp. 128–130). This view is different from IP's view of cognition being separate from the task environment and able to be isolated from the effects of mediators.

Fundamental to this view of cognition as having a social basis are the three interrelated themes that Wertsch (1985) identified as undergirding a Vygotskian perspective: a reliance on a genetic (i.e., developmental) method, the belief that higher mental processes are social in origin, and the claim that mental processes are mediated by tools and signs. The assumption behind this view is that the mind is unbounded (Smagorinsky, 1995); that is, psychological tools such as speech provide the means through which individuals internalize the higher mental processes central to social transactions and also provide the means through which they act on their environments. These tools not only mediate the development of higher mental processes, they are themselves a fundamental part of those processes. The mind, in this conception, "extends beyond the skin" (Wertsch, 1991, p. 14); that is, the mind is socially distributed and inextricably linked to the tools of mediation (Salomon, 1993). Thus the changes in consciousness that are usually the objects of psychological study are inseparable from the goal-directed, tool-mediated action through which the changes take place (Wertsch, 1985, 1991). To Vygotsky (1987), "thinking depends on speech, on the *means of thinking*, and on the child's socio-cultural experience ... the development of the child's thinking depends on his mastery of the social means of thinking, that is, on his mastery of speech" (p. 120). Protocols, therefore, are potentially tools for an instrumental process of cognitive development rather than, to use a common metaphor, windows that allow researchers to peer into workings of the mind (e.g., Hayes & Flower, 1983).

In chapter 7 of *Thinking and Speech*, Vygotsky (1987) articulated a notion of meaning that is grounded in what Wertsch (in press) identified as the *expressive* tradition of Western thought. In

this view, meaning is constructed through the process of transforming inner speech to public speech through the mediation of linguistic tools. According to Vygotsky

> Thought is not only mediated externally by signs. It is mediated internally by meanings. The crux of the matter is that the immediate communication of consciousness is impossible not only physically but psychologically. The communication of consciousness can be accomplished only indirectly, through a mediated path. This path consists in the internal mediation of thought first by meanings and then by words. Therefore, thought is never the direct equivalent of word meanings. Meaning mediates thought in its path to verbal expression. The path from thought to word is indirect and internally mediated. (p. 282)

Here Vygotsky argued that thinking achieves meaning on its way to articulation. Through articulation it then achieves coherence through its expression in a set of signs that has a meaning potential and thus potential for communication:

> Even at the outset, then, thought and word are not cut from a single mold. In a certain sense, one can say that we find more opposition than agreement between them. The structure of speech is not a simple mirror image of the structure of thought. It cannot, therefore, be placed on thought like clothes off a rack. Speech does not merely serve as the expression of developed thought. Thought is restructured as it is transformed into speech. It is not expressed but completed in the word. Therefore, precisely because of their contrasting directions of movement, the development of the internal and external aspects of speech form a true unity. (p. 251)

Through this process of articulation, inner speech is restructured, transformed from "a predicative, idiomatic speech into the syntax of a differentiated speech which is comprehensible to others" (p. 280). In Vygotsky's view the mind should not be conceived of as being organized in memory nodes:

> Thought is always something whole, something with significantly greater extent and volume than the individual word. ...*What is contained simultaneously in thought unfolds sequentially in speech.* Thought can be compared to a hovering cloud which gushes a shower of words. (p. 281)

Thinking only makes social sense after being transformed to the cultural artifact of the word, and those making social sense of the words include both the speaker and the addressees.

Interest in the expressive functions of language has motivated much research on learning. Barnes (1992), in analyzing classroom discourse, argued strongly in favor of encouraging "exploratory talk" (p. 28) as a means of assimilating and accommodating new knowledge to old, arguing that "the more [a learner] is enabled to think aloud, the more he can take responsibility for formulating explanatory hypotheses and evaluating them" (p. 29). Used as a means of learning, "speech and writing [can serve] as an instrument for reshaping experience, that is, as a means of learning" (p. 84). Wells and Chang-Wells (1992) similarly argued in favor of "a conception of literacy as a mode of thinking that deliberately makes use of language, whether spoken or written, as an instrument for its own development" (p. 123). This view has also inspired a great deal of interest in *writing to learn*, a pedagogical approach in which writing is viewed as a tool for exploring a subject (Applebee, 1981). In all of these approaches, speech and speech-based activities such as writing are assumed to serve as vehicles through which thinking is articulated, transformed into an artifactual form, and then available as a source of further reflection. The processes of rendering

thinking into speech is not simply a matter of memory retrieval, but a process through which thinking reaches a new level of articulation.

If a researcher adopts this assumption, collecting and analyzing protocols becomes highly problematic. If thinking becomes rearticulated through the process of speech, then the protocol is not simply representative of meaning, but an agent in the production of meaning. What is studied, to use Vygotsky's (1987) metaphor, is the shower of words and not the storm cloud of thought. Although one generates the other, they are not the same. Both are dynamic, and both are continually in a process of "unfolding" (Vygotsky, 1987, p. 280). The analysis of rainfall can lead to inferences about the type of cloud that produced it but not to the construction of a model of how that specific cloud functions (J. Smagorinsky, personal communication, August 16, 1997).[2] And anyone undertaking a study of the relation between clouds and rain needs to keep in mind the fact that the process of raining changes the constitution of the clouds.

The problem is much more complex when analyzing thinking and speech. Clouds, although having a history and existing within a context, do not have a consciousness or live within a culture; they have no memory, no volition, no tools, no motive. The problems of analyzing the artifact of speech, under the assumption that there is a dialectic relation between thinking and speech, are virtually limitless given the range of variables potentially available to confound any interpretation.

Researchers who adopt this perspective must take into account

1. The ways in which the tool-and-sign (or, in Cole's, 1996, terms, *artifactual*) function of speech gives it a mediational role in data collection. As a mediator it serves as a means of articulation of thought into a socially comprehensible form. The formal features of speech are determined by the participant's internalized cultural practices and the contingencies that determine appropriate genres for the situation.

2. The ways in which the process of providing a protocol will potentially prompt changes in consciousness through the expressive, exploratory, transformational process of articulation. Any inferences made from a protocol thus need to account for the dynamic, unfolding natures of thinking and speech and their dialectic relation.

AN ALTERNATIVE THEORETICAL GROUNDING FOR PROTOCOL ANALYSIS

To paraphrase Shakespeare, I have not come to bury IP, but to provide an alternative way of viewing protocol analysis, one of its chief methodological tools. Indeed, I have little but praise for Ericsson and Simon's (1984) monumental justification of protocol analysis, *Protocol Analysis: Verbal Reports as Data* and, from an IP perspective, the comprehensiveness and consistency of their argument. An IP researcher would undoubtedly find the rationale for a CHAT perspective to rest on far shakier ground. I readily acknowledge that my argument is considerably more speculative than that of Ericsson and Simon, whose admirable diligence and thoroughness in justifying their approach is virtually unmatched. Yet the studies I have conducted using both protocol analysis

---

[2]Joseph Smagorinsky, in addition to being my father, was a pioneer in the development of the General Circulation Model as a tool for weather forecasting (see, e. g., J. Smagorinsky, 1963). I thank Lev Vygotsky for providing the analogy between rain and speech, thus creating the rare occasion for my work to overlap with my dad's.

and its methodological cousin, stimulated recall, have raised some doubts about their assumptions about the social nature of speech, enough to prompt me to search for alternatives. Stephen Hawking (1988), in discussing the generation of theories, pointed out that

> any physical theory is always provisional, in the sense that it is only a hypothesis: you can never prove it. No matter how many times the results of experiments agree with some theory, you can never be sure that the next time the result will not contradict the theory. On the other hand, you can disprove a theory by finding even a single observation that disagrees with the predictions of the theory. (p. 10)

Although my relatively few studies have not disproved IP theory, they have raised doubts. Through this article I have tried to propose an alternative way of thinking about protocol analysis based on the ways in which a CHAT perspective has helped me think about those doubts.

At the end of each of the three sections devoted to the analysis of particular areas of concern, I have offered suggested areas of emphasis for those using protocol analysis from a CHAT perspective. In the aggregate they call for an analysis of the *activity setting* in addition to the *protocol*. In other words a protocol should not be analyzed only for what it allows a researcher to infer about the individual mind, but should be analyzed as a situated practice with antecedent cultural history. From a practical standpoint, this task is not merely formidable but both impossible and problematic. There is, after all, a lot of history, and it would not be possible to say with certainty which historical actions provided the significant channels for the action under study and which of the overlapping historical paths would determine which would prevail. History can only be partially reconstructed, and so the cultural precedents for a protocol could only be sampled and inferred. This problem is central to any research conducted from a CHAT perspective. A second related problem concerns the perspective adopted to tell that history. As many (e.g., Foucault, 1972) have pointed out, any historical account is a narrative told with bias and agenda. It is necessarily selective and pointed. Providing a historical context for a protocol is thus a subjective process. Again, this problem is inherent in all CHAT approaches.

From a practical standpoint, telling this history makes for extremely long research reports in which the background information potentially dwarfs the protocol data. If the research is ever to reach the public (and the promotion requirements of most researchers demand that it does) then the researcher needs to reduce this accumulated history to its salient points. What is salient, of course, depends on what the researcher wants to demonstrate. One solution is for the researcher to acknowledge biases and agendas and qualify all claims in terms of personal contingencies. All of these moves—accounting for cultural background and researcher agendas—require adjustments in the genre of research reports. A CHAT perspective on protocol analysis, then, will require both methodological adjustments, interpretive adjustments, and substantial changes in the genre of the research report.

From a CHAT perspective, however, these changes are all needed. Newman et al. (1989) emphasized that *"the individual is not the most useful unit of analysis"* in psychological research (p. 59), arguing instead that activity within a social setting should be the focus of study. The relevant settings require some explication for data to make sense. These zones of proximal development (Vygotsky, 1978) provide tools, constraints, and communities of practice that channel the emergence of the verbal report. Collecting the data or conducting the analysis without acknowledging the social context that helps shape their emergence ignores the contingencies that provide the arena and social significance of their production.

ACKNOWLEDGMENTS

REFERENCES

Ackerman, J. (1983). The promise of writing to learn. *Written Communication, 10*, 334–370.

Applebee, A. N. (1981). *Writing in the secondary school: English and the content areas* (NCTE Research Report No. 21). Urbana, IL: National Council of Teachers of English.

Bakhtin, M. M. (1981). *The dialogic imagination: Four essays by M. M. Bakhtin* (M. Holquist, Ed., and C. Emerson & M. Holquist, Trans.). Austin: University of Texas Press.

Bakhtin, M. M. (1984). *Problems of Dostoevsky's poetics* (C. Emerson, Ed. & Trans.). Minneapolis: University of Minnesota Press.

Bakhtin, M. M. (1986). *Speech genres and other late essays* (C. Emerson & M. Holquist, Ed., and V. W. McGee, Trans.). Austin: University of Texas Press.

Barnes, D. (1992). *From communication to curriculum* (2nd ed.). Portsmouth, NH: Heinemann.

Bereiter, C., & Scardamalia, M. (1987). *The psychology of written composition*. Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Bracewell, R. J., & Breuleux, A. (1994). Substance and romance in analyzing think-aloud protocols. In P. Smagorinsky (Ed.), *Speaking about writing: Reflections on research methodology* (pp. 55–88). Thousand Oaks, CA: Sage.

Claparede, E. (1934). Genese de l'hypotheses [Genesis of they hypotheses]. *Archives de Psychologie, 24*, 1–155.

Cole, M. (1979). New vodka in an old bottle. *Contemporary Psychology, 24*, 615–619.

Cole, M. (1992). Context, modularity, and the cultural constitution of development. In L. T. Winegar & J. Valsiner (Eds.), *Children's development within social context, Volume 2: Research and methodology* (pp. 5–31). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Cole, M. (1996). *Cultural psychology: A once and future discipline*. Cambridge, MA: Harvard University Press.

Dansereau, D., & Gregg, L. W. (1966). An information processing analysis of mental multiplication. *Psychonomic Science, 6*, 71–72.

Duncker, K. (1926). A qualitative (experimental and theoretical) study of productive thinking (solving of comprehensible problems). *Pedagogical Seminar, 33*, 642–708.

Durkin, H. E. (1937). Trial-and-error, gradual analysis and sudden reorganization: An experimental study of problem solving. *Archives of Psychology, 210*.

Ericsson, K. A., & Simon, H. A. (1978). *Retrospective verbal reports as data* (C.I.P. Working Paper No. 388). Pittsburgh, PA: Carnegie-Mellon University.

Ericsson, K. A., & Simon, H. A. (1979). *Thinking-aloud as data: Effects of verbalization* (C.I.P. Working Paper No. 397). Pittsburgh, PA: Carnegie-Mellon University.

Ericsson, K. A., & Simon, H. A. (1980). Verbal reports as data. *Psychological Review, 87*, 215–253.

Ericsson, K. A., & Simon, H. A. (1984). *Protocol analysis: Verbal reports as data*. Cambridge, MA: MIT Press.

Ericsson, K. A., & Simon, H. A. (1993). *Protocol analysis: Verbal reports as data* (2nd ed.). Cambridge, MA: MIT Press.

Feldman, J. (1959). *An analysis of predictive behavior in a two-choice situation*. Unpublished doctoral dissertation, Carnegie Institute of Technology, Pittsburgh, PA.

Flanagan, J. C. (1954). The critical incident technique. *Psychological Bulletin, 51*, 327–358.

Flower, L. S., & Hayes, J. R. (1977). Problem-solving strategies and the writing process. *College English, 39*, 449–461.

Flower, L. S., & Hayes, J. R. (1980). Identifying the organization of writing processes. In L. W. Gregg & E. R. Steinberg (Eds.), *Cognitive processes in writing* (pp. 3–30). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Foucault, M. (1972). *The archaeology of knowledge and the discourse on language*. New York: Pantheon.

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

Hawking, S. W. (1988). *A brief history of time: From the big bang to black holes.* New York: Bantam.

Hendrix, G. (1947). A new clue to transfer of training. *Elementary School Journal, 48,* 197–208.

Holquist, M. (1981). Glossary. In M. Holquist (Ed.), *The dialogic imagination: Four essays by M. M. Bakhtin* (pp. 423–434). Austin: University of Texas Press.

James, W. (1890). *The principles of psychology.* New York: Holt.

Lashley, K. S. (1923). The behavioristic interpretation of Consciousness II. *Psychological Review, 30,* 329–353.

Lee, B. (1985). Intellectual origins of Vygotsky's semiotic analysis. In J. V. Wertsch (Ed.), *Culture, communication, and cognition: Vygotskian perspectives* (pp. 66–93). New York: Cambridge University Press.

Leont'ev, A. N. (1981). *Problems in the development of the mind.* Moscow: Progress Publishers.

Luria, A. R. (1932). *The nature of human conflicts.* New York: Liveright.

Newell, A., & Simon, H. A. (1972). *Human problem solving.* Englewood Cliffs, NJ: Prentice Hall.

Newman, D., Griffin, P., & Cole, M. (1989). *The construction zone: Working for cognitive change in school.* New York: Cambridge University Press.

Nisbett, R. E., & Wilson, W. T. D. (1977). Telling more than we can know: Verbal reports on mental processes. *Psychological Review, 84,* 231–259.

Rosenthal, R. (1966). *Experimenter effects in behavioral research.* New York: Appleton-Century-Crofts.

Rubin, J. Z., Provenzano, F. J., & Luria, Z. (1974). The eye of the beholder: Parents' views on sex of newborns. *American Journal of Orthopsychiatry, 44,* 512–519.

Ruger, H. A. (1910). The psychology of efficiency. *Archives of Psychology, 15.*

Russo, J., Johnson, E., & Stephens, D. (1989). The validity of verbal protocols. *Memory & Cognition, 17,* 759–769.

Salomon, G. (Ed.). (1993). *Distributed cognitions: Psychological and educational considerations.* New York: Cambridge University Press.

Skinner, B. F. (1957). *Verbal behavior.* London: Methuen.

Smagorinsky, J. (1963). General circulation experiments with the primitive equations. I. The basic experiment. *Mon. Weather Rev., 91,* 99–164.

Smagorinsky, P. (1989). The reliability and validity of protocol analysis. *Written Communication, 6,* 463–479.

Smagorinsky, P. (1991). The writer's knowledge and the writing process: A protocol analysis. *Research in the Teaching of English, 25,* 339–364.

Smagorinsky, P. (1994). Think-aloud protocol analysis: Beyond the black box. In P. Smagorinsky (Ed.), *Speaking about writing: Reflections on research methodology* (pp. 3–19). Thousand Oaks, CA: Sage.

Smagorinsky, P. (1995). The social construction of data: Methodological problems of investigating learning in the zone of proximal development. *Review of Educational Research, 65,* 191–212.

Smagorinsky, P. (1997). Personal growth in social context: A high school senior's search for meaning in and through writing. *Written Communication, 14,* 63–105.

Smagorinsky, P., & Coppock, J. (1994). Cultural tools and the classroom context: An exploration of an alternative response to literature. *Written Communication, 11,* 283–310.

Smagorinsky, P., & Coppock, J. (1995a). The reader, the text, the context: An exploration of a choreographed response to literature. *Journal of Reading Behavior, 27,* 271–298.

Smagorinsky, P., & Coppock, J. (1995b). Reading through the lines: An exploration of drama as a response to literature. *Reading & Writing Quarterly, 11,* 369–391.

Stratman, J. F., & Hamp-Lyons, L. (1994). Reactivity in concurrent think aloud protocols: Issues for research. In P. Smagorinsky (Ed.), *Speaking about writing: Reflections on research methodology* (pp. 89–112). Thousand Oaks, CA: Sage.

Tulviste, P. (1991). *The cultural–historical development of verbal thinking.* Commack, NY: Nova Science.

Valsiner, J. (in press). *The guided mind: A sociogenetic approach to personality.* Cambridge, MA: Harvard 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.

Vygotsky, L. S. (1987). Thinking and speech. In R. Rieber & A. Carton (Eds.), *L. S. Vygotsky, Collected works* (Vol. 1, pp. 39–285). New York: Plenum.

Watson, J. B. (1920). Is thinking merely the action of language mechanisms? *British Journal of Psychology, 11,* 87–104.

Wells, G., & Chang-Wells, G. L. (1992). *Constructing knowledge together: Classrooms as centers of inquiry and literacy.* Portsmouth, NH: Heinemann.

Wertsch, J. V. (1981). The concept of activity in Soviet psychology: An introduction. In J. V. Wertsch (Ed. & Trans.), *The concept of activity in Soviet psychology* (pp. 3–36). Armonk, NY: Sharpe.

Wertsch, J. V. (1985). *Vygotsky and the social formation of mind.* Cambridge, MA: Harvard University Press.

Wertsch, J. V. (1991). *Voices of the mind: A sociocultural approach to mediated action.* Cambridge, MA: Harvard University Press.

Wertsch, J. V. (in press). Vygotsky's two minds on the nature of meaning. In C. D. Lee & P. Smagorinsky (Eds.), *Worlds of meaning: Vygotskian perspectives on literacy research.* New York: Cambridge University Press.

Yaroshevsky, M. (1989). *Lev Vygotsky.* Moscow: Progress Publishers.