

UC Merced

Proceedings of the Annual Meeting of the Cognitive Science Society

Title

The Structure of Reasoning in Conversation

Permalink

<https://escholarship.org/uc/item/70n4f8mb>

Journal

Proceedings of the Annual Meeting of the Cognitive Science Society, 13(0)

Authors

Resnick, Lauren B.

Salmon, Marrilee H.

Zeitz, Colleen M.

Publication Date

1991

Peer reviewed

The Structure of Reasoning in Conversation¹

Lauren B. Resnick
Learning Research and
Development Center
University of Pittsburgh, 15260

Merrilee H. Salmon
History & Philosophy of Science
University of Pittsburgh, 15260

Colleen M. Zeitz
Learning Research and
Development Center
University of Pittsburgh, 15260

Abstract

The findings of philosophers, linguists, and psychologists are conjoined here in an effort to develop a descriptive/analytic account of reasoning as it actually occurs in social settings. The primary focus of this paper is the reasoning that occurs in discussions of controversial social issues by groups of peers. Preliminary analysis indicates that rather sophisticated argument structures emerge from these informal settings, and that conversational interaction stimulates the development of arguments. Although participants did not always fully state their arguments, the investigators felt justified in attributing implicit premises because these were referred to later in the conversation *as if they had been stated*. In this respect at least, instead of merely assuming that subjects are good at reasoning, this study provides evidence for the claim.

In this paper, a system for coding elements of reasoning and a method for displaying the interactive structure of reasoning in conversations are developed. A long-term goal is to use the information gained from this study to help understand and correct two problems that arise in the teaching of reasoning: the difficulty many students have with acquiring the principles of reasoning in standard logic courses and the difficulty of transferring whatever reasoning skills are acquired in the classroom to new situations.

Introduction

George Herbert Mead called thought a "conversation with the generalized other," implying that as we think individually we attempt to respond--internally and vicariously--to the imagined responses of others to our ideas and arguments. His formulation suggests the study of actual conversation in order to analyze the public forms of reasoning that are thought to lie at the roots of private forms of competence. The study of reasoning as a form of social practice has only recently entered the mainstream of psychological research, influenced heavily by the rediscovery of Vygotsky. He, like Mead, offered a vision of human

thinking grounded in social life. Both saw private reasoning as an internalization of processes originally carried out publicly and in interaction with others. In examining the actual processes of shared reasoning, an obligation is incurred to understand human reasoning in broader terms than those offered by formal logic and statistics. This work thus departs from studies by psychologists in which a major concern is the explanation of why human reasoning does not always conform to accepted normative standards (Braine & Rumain 1963; Johnson-Laird 1983; Nisbett & Ross 1980; Tversky & Kahnemann 1974). Piaget, whose work traces the acquisition of normative logico-mathematical structures and the effects of their absence on children's reasoning, also falls within this normative tradition.

Within cognitive science, challenges to the dominant role of formal logic as an account of human reasoning are producing growing concern for the role of argument, contradiction, and negotiation processes. Doubts that thought can be fully accounted for in terms of an individual's processing a set of symbols with fixed meanings are leading some cognitive scientists to press for theories of cognition that are more connected to both the physical and the social world. The metaphor of cognitive systems as social systems in connectionist and blackboard models of thinking makes the entire cognitive science community more open than it was a decade ago to the idea of knowledge as distributed across several individuals whose interactions determine decisions, judgments, and problem solutions. Sharing with the Soviet-originated *activity theory* (Leonte'ev 1981) an antifunctionalist point of view in which intentionality and affect are components of cognitive activity, American theorists of situated cognition question whether a cognitive core that is independent of context and intention can be found (Brown, Collins, & Duguid 1989; Greeno 1988; Lave 1988; Suchman 1987). Our project attempts to show how the forms of discourse are intimately related to reasoning, and in doing so forges multidisciplinary links to rhetoric, informal logic (Grize & Pieraut-LeBonniec 1983;

¹Credits

The authors are grateful to the Andrew W. Mellon Foundation for supporting this work.

Toulmin 1958), pragmatics (Grice 1989; Searle 1983) and the structure of conversation (Clark 1978; Schegloff, in press; Sperber & Wilson 1986).

Situations of shared reasoning. In studying reasoning as a form of social practice, we assume that the structure of reasoning depends significantly not only on the content of the conversation, but also on the nature of the situation in which that reasoning occurs. For example, features likely to affect the course of reasoning include the relative social status of the participants, the goal that the group adopts for the conversation, the goals of each participant, the kinds of physical displays available, and who can see or manipulate these displays. This project examines several conversational situations in which reasoning occurs: classroom discussions led by a teacher, joint problem-solving sessions related to schoolwork (some involving manipulable computer displays), and discussions of controversial social issues by groups of peers.

An analysis of a conversation among three university students is reported here. Volunteers from a course on philosophy of science and public policy were organized into groups of three with two initially opposed to nuclear power and one in favor of it. They were instructed to discuss nuclear power for about twenty minutes with the goal of reaching a consensus. Their discussions were videotaped and transcribed.

Preliminary analysis. After viewing the tape several times, the investigators framed three broad categories of analysis: Translation (an interpretation by the researchers of the actual utterances of the subjects); Logic (an outline of the patterns of reasoning); and Discourse (other linguistic, social, and interpersonal aspects of conversation).

A. Translation. Each speaker was identified by a letter. Grammatical units that approximated sentences were given separate line numbers. In "translating" sentences, referents to pronouns, dates, and times were secured. When false starts and qualifiers seemed not directly relevant to the line of reasoning, they were transferred to the Discourse category for later analysis. To check reliability, investigators independently constructed translations. The degree of intersubjective agreement obtained provided reasonable assurance that the translations articulated more fully the intentions of the speaker instead of imposing new meanings that the speaker did not intend.

Subjects often made elliptical claims that could be construed as parts of arguments. Whenever missing elements were supplied, the interpolations were presented alongside the actual words of the participants. The appended transcription is a reprinting

of part of the protocol with actual words of the participants in the left column and translations and interpolations in the right column. The label "T" is used to indicate a translation. For example, TC4.2 denotes our translation of speaker C's words in 4.2. Interpolated elements of arguments are marked "L."

B. Logic. In accordance with the goal of understanding the structure of reasoning under conditions of conversation, but also recognizing that only a limited number of variables could be considered in the first round of analysis, a coding system (summarized in appended Logic Key) was devised to pick out salient features of reasoning.

C. Discourse. Analysis of pragmatic features of conversations less obviously relevant to reasoning than those coded in the logic category is scheduled to begin this summer.

Analysis of the structure of reasoning. Two questions motivated this research. One was whether people actually engage in reasoning in conversational settings, or, as many critics complain, people simply state opinions and beliefs without attempting to mount arguments for them. The second, more open-ended, question focused on how the conversational setting and interplay between several participants encouraged or discouraged the use of reasoning skills.

Most studies of reasoning, even the recent literature on informal reasoning and critical thinking, ignore social aspects of the topic while emphasizing patterns of individual reasoning. With few exceptions, such as "brainstorming" sessions in which people try to gain insights to solve specific problems, and the presentation of scholarly papers, where arguments are offered to peers for critical evaluation, reasoning is conceived as a solitary activity engaged in rather infrequently, and then as a response to puzzle-solving pressure. Nevertheless, in response to the first question, it was apparent that the subjects, who might have used various nonargumentative techniques such as social pressure to reach consensus, instead constructed fairly elaborate arguments that were recognized and responded to appropriately by their peers. Although not trained as debaters, subjects employed standard techniques such as offering concessions to preempt criticisms of their own arguments or, alternatively, capitalizing on opponent's concessions to support a counterargument.

Some insight into the problem of unstated premises emerged from the study. Social rules governing conversation (cf. Grice 1989) suppress the explicit statement of claims that are believed obviously acceptable to parties in a conversation. In trying to reconstruct conversational arguments, however, making implicit claims explicit is problematic. Does one always assume that the person presenting the

argument has in mind a premise that will make the argument succeed, or does one count failure to make a premise explicit a failure in reasoning? In this study, assignment of some unstated premises and conclusions was amply justified by specific references made at later points in the discourse to these unstated claims. Because no participant protested that these had not been stated or were not intended, one could safely assume that no party disputed their role in the arguments.

Figure 1 represents the first minute of the transcribed conversation. Premises of arguments are indicated by triangles and conclusions by rectangles. Either may be stated explicitly (solid lines) or implied (dotted lines). *Factual* premises, which are specific to a topic under discussion, are distinguished from *theoretical* premises, which are taken to be general beliefs shared by most members of the participants' culture. Premise LC4.3i ("Energy choice is limited to nuclear power or fossil fuels") is an example of a factual implied premise. Premise LC4.3ii ("The less costly alternative should be chosen") is a theoretical premise. Because theoretical premises form part of a widely shared cultural system of beliefs, they are rarely challenged or even acknowledged. As part of this project, additional experiments have been undertaken to validate attributions of implied premises. Challenges and responses to them (diamonds) and concessions (hexagons) are also identified as basic elements of reasoning. This represents a departure from most studies of reasoning in which only premises and conclusions are regarded as components of arguments. Premises are generally understood to be claims that could be either true or false, whereas challenges and concessions can be questions, doubts, or exclamations to which it may not even make sense to supply a truth value. Nevertheless, challenges and the like form parts of coherent structures of reasoning. Far from being extraneous or irrelevant, they form and guide reasoning in clearly recognizable ways. In our structural diagrams of conversational reasoning, the challenges and concessions are the most densely interconnected components. This indicates that they are doing important work in moving arguments forward in ways that are not captured by canonical formal logical categories.

Bolded rectangles and ovals surround whole argument structures, each made up of several of the basic elements just described. Ovals indicate that an argument structure constitutes an attack on a previous argument structure. One argument structure can be embedded within another. For example, premises B8.3 and TB8.4a, leading to conclusion TB8.4b, constitute an argument structure inside an attack.

Arrows show how sentences refer to one another or how arguments are related to other parts of the conversation.

Figure 1 displays two argument structures, one presented by participant C, the second by participant B. Participant C builds an argument for her opening statement in favor of using nuclear power (LC4.1). She begins by conceding the negative costs of nuclear power (TC4.2) and then employs three premises. Only the premise that fossil fuels are more costly than nuclear power is explicit (TC4.3). Two (implicit) premises are supplied by the researchers. All four elements--the concession, the stated premise, and the two implicit premises--constitute support for the conclusion that nuclear power should be used.

Because C holds the minority position in this group, this argument comes under considerable attack. Initially B attacks the argument as a whole (B8.1) and supports the position with an embedded argument. B's stated premise in B8.2, that ". . . there are alternative methods we can use," is a negation of C's implicit premise (LC4.3i) that energy choice is limited to nuclear power or fossil fuels. This constitutes the first validation of our assignment of the implicit premise to C. Other instances of this type of validation occur in later parts of the conversation. Premises B8.3 and TB8.4a, leading to the conclusion that the consequences of nuclear power are too harsh to consider its use (TB8.4b), intensify B's initial position against the use of nuclear power (LB8.1), which is in turn a negation of C's conclusion.

Concluding Discussion

The present methodologically oriented paper is but an early report on a new line of work. With the tools developed here, further analysis can help expose how people reason cooperatively in social settings. This analysis goes beyond those that have become conventional, even in studies of informal logic, in treating as integral parts of arguments not only premises and conclusions but also other elements such as challenges, responses to challenges, and concessions. Some progress toward solving the troublesome problem of identifying and attributing implicit premises has resulted from this work.

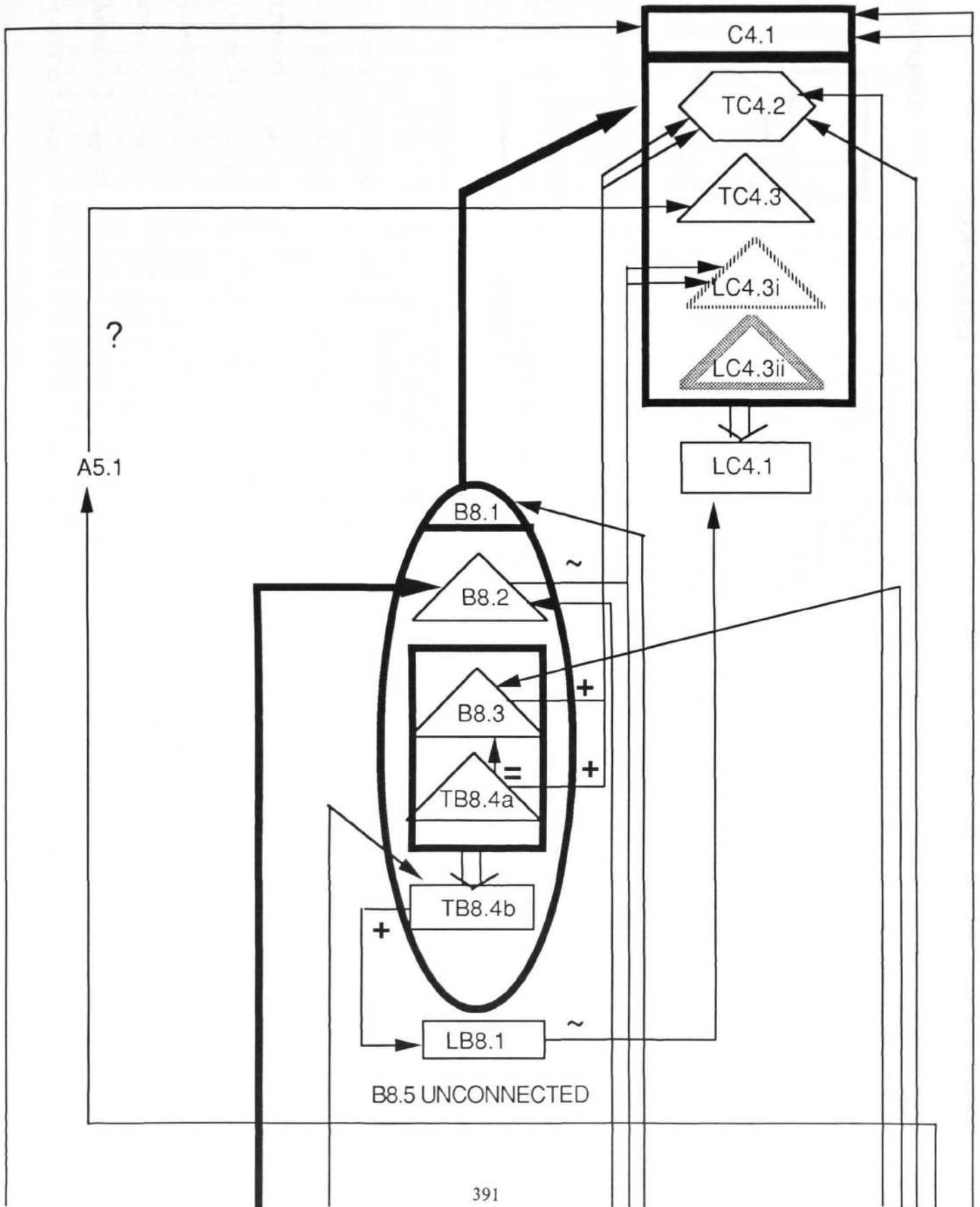
In the small sample of conversations analyzed thus far, the coherence of the reasoning displayed is impressive. Participants listen carefully to each other and construct their arguments in relation to what others say. More specifically, they appear to build complex argument and attack structures. People appear to be capable of recognizing these structures and effectively attacking component parts as well as whole arguments. The discussants disarm anticipated (or previous) arguments by first making concessionary

Group A Nuclear

A

B

C



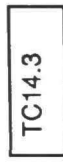
LOGIC KEY

Transcription of Discussion

Actual Statements Added translations and premisses

A1: What do you think about nuclear power?
 C2: Well!
 A3: What's your position?
 C4.1: My position is that I advocate it
 LC4.1: Nuclear power should be used
 C4.2: 'n I realize that there are definite costs
 TC4.2: I realize that there are definite costs to nuclear power.
 C4.3: but I also feel that there are costs um . I think more prevalent when um . you're talking about fossil fuels
 LC4.3i: Energy choice is limited to nuclear power or fossil fuels.
 LC4.3ii: The less costly alternative should be chosen.
 A5: What do you...think about fossil fuels what do they do?
 C6: Well why don't you guys give your positions first before []//
 A7: Ok
 B8.1: Allright, um well I'm against it
 LB8.1: Nuclear power should not be used.
 B8.2: because I believe there are alternative methods we can use..
 B8.3: um the consequences of nuclear power are just too disastrous
 B8.4: they're just they're too harsh to even consider it
 TB8.4a: The consequences of nuclear power are so harsh
 TB8.4b: that you cannot even consider using nuclear power.
 B8.5: and you can't predict the probability of what's gonna happen and what's not gonna happen..

SHAPES



= CONCLUSION



= IMPLIED CONCLUSION



= PREMISS



= FACTUAL IMPLIED PREMISS



= THEORETICAL IMPLIED PREMISS



= CHALLENGE OR ANSWER TO CHALLENGE

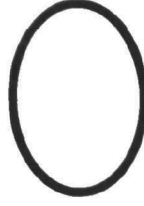


= CONCESSION

GROUPINGS



= AN ARGUMENT



= AN ATTACK

VARIOUS TYPES OF LINKS



= CONNECTS ARGUMENTS & CONCLUSIONS



= CONNECTS ATTACKS & WHAT THEY ATTACK



= VARIOUS TYPES OF LINKS (SEE IMMEDIATELY BELOW)

A) '+' = INTENSIFIER

B) ':' = LESS STRONG VERSION

C) 'eg' = EXAMPLE

D) '=' = EQUIVALENT

E) '~' = NEGATION

F) 'ans' = ANSWERS

G) 'gen' = GENERALIZATION

H) 'opp' = OPPOSITION

statements and then weakening or attacking these statements themselves.

Although plausible alternatives to the clever argumentative strategies we describe exist, subjects in our studies appeared to avoid them. Very few assertions occur that do not play some role in an argument structure, and rarely are claims asserted without some supporting reasons. This indicates that our subjects were interactive as they built argument structures. The discussants might have dropped arguments midstream or inserted numerous irrelevant utterances into an otherwise coherent argument. Subjects could have attacked positions that none of the other discussants was willing to defend ("straw men"). If our subjects had not apprehended the force of arguments, they might have failed to attack others' arguments or failed to rebut attacks of their own arguments. In fact, the protocols examined to date contain very few instances of these types of error.

These observations point to a number of questions that will be the object of future investigations. To test how widespread the capacity for shared reasoning is, the structure of discussions of social issues by groups of different ages and different levels of education will be compared.

The question of how specific linguistic and conversational structures might support or inhibit reasoning will also be pursued by analyzing the "Discourse" features of the present corpus of material. Other experiments will set up conditions of "discussion" in which the normal face-to-face conditions are partly interrupted. For example, a study is underway in which subjects watch videotapes of several minutes of discussion and then respond as if they were members of the discussion group they watched. Computer-mediated conversations, which are an intriguing newer form of social practice, may also be investigated.

References

- Braine, M. D. S., and Romain, B. 1963. Logical Reasoning. In P. H. Mussen (Ed.), *Handbook of Child Psychology* (Vol. III, pp. 263-340). N.Y.: Wiley.
- Brown, J. S., Collins, A., and Duguid, P. 1989. Situated Cognition and the Culture of Learning, *Educational Researcher* 18(1):32-42.
- Clark, H. 1978. Inferring What is Meant. In W. Levelt and G. Flores d'Arcais (Eds.), *Studies in the Perception of Language*. Chichester: Wiley.
- Greeno, J. G. 1988. Situations, Mental Models, and Generative Knowledge, Report No. IRL88-0005. Palo Alto, Calif.: Institute for Research on Learning.
- Grice, H. P. 1989. *Studies in the Way of Words*. Cambridge, Mass.: Harvard University Press.
- Grize, J-B., and Pieraut-LeBonniec, G. 1983. *La Contradiction: Essai sur les Operations de la Pensee*. Paris: Presses Universitaires de France.
- Johnson-Laird, P. 1983. *Mental Models*. Cambridge: Cambridge University Press.
- Lave, J. 1988. *Cognition in Practice*. Cambridge: Cambridge University Press.
- Leontev, A. N. 1981. The Problem of Activity in Psychology. In J. V. Wertsch (Ed.), *The Concept of Activity in Soviet Psychology* (pp. 37-71). Armonk, N.Y.: M. E. Sharpe.
- Nisbett, R., and Ross, L. 1980. *Human Inference: Strategies and Shortcomings of Social Judgment*. Englewood Cliffs, N.J.: Prentice-Hall.
- Schegloff, E. A. in press. Conversation Analysis and Socially Shared Cognition. In L. B. Resnick, J. Levine, and S. D. Behrend (Eds.), *Socially Shared Cognition*. Washington, D.C.: American Psychological Association.
- Searle, J. 1983. *Intentionality*. Cambridge: Cambridge University Press.
- Sperber, D., and Wilson, D. 1986. *Relevance: Communication and Cognition*. Cambridge, Mass.: Harvard University Press.
- Suchman, L. A. 1987. *Plans and Situated Actions: The Problem of Human-Machine Communication*. Cambridge: Cambridge University Press.
- Toulmin, S. 1958. *The Uses of Argument*. Cambridge: Cambridge University Press.
- Tversky, A., and Kahnemann, D. 1974. Judgment Under Uncertainty: Heuristic and Biases. *Science* 185:1124-1131.