12 UNDERSTANDING FAILURES IN ORGANIZATIONAL DISCOURSE

THE ACCIDENT AT THREE MILE ISLAND AND THE SHUTTLE CHALLENGER DISASTER

CARL G. HERNDL, BARBARA A. FENNELL, AND CAROLYN R. MILLER

Introduction

The Rogers Commission's report on the space shuttle Challenger accident concluded that there was a "serious flaw in the decision making process" that led to the disastrous launch of the shuttle on January 28, 1986; it also found management practices "at odds with" the need for NASA's Marshall Space Flight Center "to function as part of a system . . . communicating with the other parts of the system" (Presidential Commission 1:104). Misunderstanding and miscommunication, in other words, were found to be contributing causes of the accident.

Earlier, the Nuclear Regulatory Commission's report on the accident at Three Mile Island found that a "breakdown of communications" and "crucial misunderstanding" within Babcock & Wilcox, the manufacturer of the nuclear reactor involved, were precursor events to that disaster (Rogovin and Frampton, 161). One of the documents under examination by the commission was later called a $2.5 billion memorandum (*ADE Bulletin*).

Both these technological disasters involved failures of communication among ordinary professional people, mistakes committed in the course

of routine work on the job, small mishaps with grotesque consequences. Enormous amounts of routine communication are done unthinkingly every day by large numbers of professional people; most of it disappears into the files and remains unremarked and unexamined by scholars interested in professional communication. But disaster makes otherwise routine and invisible communication accessible, and disaster makes the study of it compelling. We propose here, not to account for these communication failures in any comprehensive way, but to use them to investigate the relationship between communication and social structures.

This focus derives from earlier work by one of us suggesting that the linguistic behavior of professionals in large organizations is in part shaped by their group affiliation, specifically, that technical people tend to distinguish themselves from managers linguistically by preferring certain structures in their writing (superfluous nominalizations and narratives), even after demonstrating themselves capable of recognizing and using other structures preferred by managers (Brown and Herndl). The notion that subgroups within an organization may be differentiated not only by their work relationships but also by the way they use language suggests a possible reason for miscommunication within such an organization. Communication failures may be caused, at least in part, by the differentiation of discourse along the lines of social structure.

Bureaucratic organizations are richly differentiated social structures, subdivided into functional, geographical, and hierarchical subgroups. Members of organizations talk in ways that suggest that the divisions are real to them, not just fictions of the organization chart; they designate other groups as "the people across the street," or "those folks on the other side of the building"; they personify functional names and hierarchical relationships: "accounting won't like this"; "better send this one up to the big shots." However, little previous research examines whether patterns of language use in organizations reflect the social structure. The work that has been done focuses on the ways language within such an organization differs from the language of the general environment: Agar, for example, reviews the different patterns of discourse used by representatives of an institution (such as a court or health clinic) and clients seeking the institution's services; Redish has studied the way government agencies communicate with their publics; White discusses how legal discourse affects nonlawyers.

In order to develop methods for studying discourse *within* large organizations, we wanted to cast as wide a net as possible. In fact, we were motivated to conduct a multidisciplinary study when we realized that several disciplines have developed similar ways of conceptualizing the relationship between social structure and discourse: sociolinguistics posits

the "speech community," literary theory the "interpretive community," organizational communication the "clique," argument theory the "argument field." Our study, therefore, uses several types of analysis to explore whether the discourse behind the disasters might be differentiated along the lines of social (organizational) structure and whether various discourse features will show differences corresponding to the organizational sources of the discourse. We focus particularly on formal linguistic analysis, pragmatic analysis, and argument analysis.

Communication Failure and the Three Mile Island Accident

In November 1977, roughly eighteen months before the March 1979 accident at Three Mile Island (TMI), an engineer and a manager at Babcock & Wilcox, the builder of the reactor at TMI, proposed changes in the reactor operating instructions that might well have prevented the accident. But the changes were not adopted and disseminated to reactor operators until after the accident. In testimony before the President's Commission on the Accident at Three Mile Island, the manager said, "Had my instructions been followed at TMI-II, we would not have had core damage; we would have had a minor incident" (Mathes, 1).

J. C. Mathes has written extensively on the communication problems at Babcock & Wilcox that delayed action on the proposed changes in the instructions, and our work is greatly indebted to the information he has made available. The problems we analyze here involve five memos exchanged between the Engineering branch and the Nuclear Services branch at Babcock & Wilcox. The memos are reproduced within this chapter, as figures 12.1–12.5. The sequence was as follows:

November 1, 1977: Kelly, Engineering, to "distribution," requesting discussion of new operating instructions he proposed on the basis of his investigation of an "event" at the Babcock & Wilcox reactor in Toledo, Ohio;

November 10, 1977: Walters, Nuclear Services, to Kelly, denying the need to change the instructions;

February 9, 1978: Dunn, Engineering, to Taylor, Engineering, recommending new operating procedures slightly different from those of Kelly;

February 16, 1978: Dunn, Engineering, to Taylor, Engineering, revising the recommendations of the previous memo on the basis of discussion with a person in Nuclear Services;

August 3, 1978: Hallman, Nuclear Services (actually written by Walters and signed by Hallman) to Karrasch, Engineering, requesting that Karrasch's department resolve the disagreement between Hallman's group in Nuclear Services and Dunn in Engineering about the proposed instructions.

Dunn testified that he thought the issue had been resolved after his February 16 memo and that the new operating instructions had been issued (Mathes, 83). He did not recall receiving Hallman's memo, although he is on the distribution list. Karrasch testified that he thought the Hallman memo raised "rather routine questions" and delegated someone in his unit to "follow up and take any appropriate action" (quoted in Mathes, 125, 128). Thus, no action had been taken by March 28, 1979, when a reactor "event" similar to the one at Toledo occurred at Three Mile Island; the major difference was that the Toledo reactor had been operating at low power and the TMI unit was at 97 percent power. In trying to understand this communication failure, we will first review the organizational communication analysis Mathes offers and then examine the formal linguistic features of the memos themselves, analyze the pragmatics of two of the memos, and finally compare the arguments used by the Engineering branch with those used by the Nuclear Services branch.

MATHES' ORGANIZATIONAL ANALYSIS

Mathes' analysis of the communication failure at Babcock & Wilcox blames "the system rather than the individual" (14) and makes a strong causal attribution: "Ineffective management communication procedures and practices caused the communication failure that culminated in the accident at Three Mile Island" (23). He identifies several such procedures concerning the organization as a communication environment. First, the communication networks did not correspond to the lines of authority for decision making. This problem shows up concretely in the distribution of several of the memos: Kelly sent his to a distribution list, failing to identify a primary decision maker (Mathes, 65–66); Dunn distributed "almost exclusively" in Engineering a memo requesting action that would have to be taken within Nuclear Services (25). Mathes also questions Kelly's decision to sign the memo he sent; as a low-ranking engineer, Kelly may not have had sufficient status to gain the attention of managers in other departments (62). A second inefficient procedure is the treatment of the communication process as informational rather than decision making; thus, both Kelly and Walters present "thoughts" but do not overtly recommend or reject anything (27–28). A third inefficiency that Mathes identifies is the lack of adequate feedback. Walters addressed only Kelly in his re-

sponse, but the others on Kelly's distribution list received nothing; Dunn received no feedback on his second memo and therefore assumed his recommendations had been accepted (28). A fourth problem is the mixture of formal and informal, written and oral modes of communication: Walters' memo is handwritten; Karrasch responded to Hallman's memo seven months later in a conversation at the office water cooler, a conversation that puzzled Hallman, who was unable to reach Karrasch for clarification before the TMI accident (29).

This analysis identifies important ways in which communication patterns do not correspond to the organizational structure at Babcock & Wilcox. Its focus on procedures and practices, however, on issues of communication structure (such as media and dissemination) at the expense of linguistic and rhetorical ones, takes us only part way toward understanding the relationship between social structure and discourse and, we believe, only part way toward understanding the nature of this particular failure. Mathes' "rational" ideal of management communication (54), with efficiency as the central criterion, in effect ignores the social influences on language use. Our movement in what follows is analogous to the general movement now going on in organizational communication studies, from structural and quantitative to interpretive and qualitative work (Putnam). Although both types of research assume that communication and social order are related, and further that communication helps create that order, the traditional quantitative approach sees communication as defining a pattern, or constituting a mechanism for social order, but has little to say about the qualities of social order in any given case. Such quantitative studies generally assume that a text is a static message independent of its readers; miscommunication, then, is largely a problem of transmission. The interpretive approach, on the other hand, understands communication as "the *expression* of social order" (Agar, 161; emphasis ours)—that is, communication emerges from the particular qualities of a given social group and at the same time marks its existence. Interpretive research focuses on the social production of discourse. This approach assumes that discourse is not static, that meaning is constructed by readers as well as by writers, and that both activities depend on a collective set of standards for using language that is established and maintained by a self-conscious community. In this approach, miscommunication is understood to arise from differences in the discourse practices of socially distinct groups and might better be termed misunderstanding.

FORMAL LINGUISTIC ANALYSIS

A formal, sentence-level linguistic analysis of the Babcock & Wilcox memos reveals few problems in execution that might provide a basis for

misunderstanding. Each writer generally used standard lexical and syntactic forms in his memos, and may, on this basis, be considered a competent user of English.

On the lexical level, the memos contain standard forms, supplemented, not surprisingly, by a number of abbreviated forms (HPI, RCS, PSIG, ESFAS) understood by the members of both the Nuclear Services and Engineering branches. There are only two marked examples of vocabulary use worthy of mention. The first is from the Walters memo and involves the use of *relief* as a verb, not a noun:

> Also will the code and electromagnetic valves relief water (via steam) at significant flow rate to keep the RCS from being hydroed.

The second is from the last sentence of the first Dunn memo, which uses the nominal derivative *core uncovery* from the verb phrase "to uncover the core":

> Had this event occurred in a reactor at full power with other than insignificant burnup it is quite possible, perhaps probable, that core uncovery and possible fuel damage would have resulted.

Syntactically there are few remarkable differences from standard forms in any of the memos. One exception to this general observation is in the following sentence from the first Dunn memo, which is syntactically faulty, since the *that*-clause either contains no overt subject or has a superfluous *during*:

> Such conditions guarantee full system capacity and thus assure that during any follow on transient would be no worse than the initial accident.

There is no evidence elsewhere in Dunn's writing to suggest that this is anything other than a fleeting error, however, and on the whole this memo, like all the others, demonstrates sufficient parallelism, textual cohesion, and syntactic complexity to suggest that the writer is fully competent on the formal linguistic level.

The Walters memo represents an exception to a number of the preceding observations in that it contains several errors of linguistic form. For example:

> *redundancy:* My assumption and the training assumes . . .
> *imperfect parallelism:* In talking with training personnel and in the opinion of the writer the operators at Toledo responded in the correct manner . . .
> *absence of essential punctuation:* If you intended to go solid

> what about problems with vessel mechanics. Also will the code and electromagnetic valves relief water (via steam) at a significant flow rate to keep the RCS from being hydroed.
>
> *faulty logical progression in a conditional:* If this is the intent of your letter and the thoughts behind it, then the operators are not taught to hydro the RCS everytime the HPI pump is initiated.

Unlike the other four memos, the Walters memo was handwritten, rather than typed, and the errors in linguistic form are indicative of a style of communication closer to spontaneous speech. While they are undeniably nonstandard features, they do not point to any systemic differences corresponding to social structure, and they do not seem sufficient to cause misunderstanding. At most, they indicate that Walters was writing in a different register. This brief analysis of surface linguistic form indicates that the source of the communication failure does not lie in formal linguistic features and suggests that within this organization, at least, such features do not distinguish social groups.

PRAGMATIC ANALYSIS

Pragmatic analysis considers more directly than formal linguistic analysis the ways in which social differentiation shapes discourse. Like the linguistic analysis, it suggests that the writers at Babcock & Wilcox understood one another, but it further suggests that their concern for social issues (questions of authority and public status) interfered with the recognition of the technical problem that was ostensibly at issue. As socially situated discourse, the exchange of memos ceases to be a purely technical debate.

Although current definitions of pragmatics and the scope of pragmatic analysis vary widely, the various branches of pragmatics all attempt to account for the ways in which the meaning of a speaker's utterance depends on the context in which it is used (Levinson). Such knowledge allows speakers to determine what speech acts are appropriate to their position or status and to exploit communicative conventions to "say" things which are not directly recoverable from their sentences taken out of context, as in sentence-level linguistic analysis. This knowledge allows speakers to match the self-representation implied in their speech to their understanding of the situation and to predict what inferences listeners or readers will draw from their utterance. The notion of "context" in such descriptions is always troublingly vague, but it is generally used to refer to the "social and psychological world in which the language user operates at any given time" (Ochs and Schieffelin, 1). The essential elements

of this context would include the social role and status of both speaker and listener, the temporal and physical location of both parties, the formality and style conventionally associated with a written or spoken text, and a knowledge of the subject matter (Lyons).

The interchange between Kelly and Walters (figures 12.1 and 12.2) is the clearest example of pragmatic negotiations in this situation. Kelly's memo is addressed to a distribution list of seven Babcock & Wilcox managers, five in the Engineering branch in which he works, and two in the Nuclear Services branch. The memo identifies an incident at the Toledo reactor that could have been disastrous and suggests revisions in the operating instructions to prevent any recurrence. Given the normal assumption that operating instructions should provide safe procedures rather than cause an accident, Kelly's memo constitutes an implied criticism of the Nuclear Services branch, which is responsible for training operators and writing operating instructions. As a result, Kelly couches his memo as a request for response, sacrificing propositional clarity for political expediency.

Kelly's memo shows a sharp distinction between the opening material addressed to his Babcock & Wilcox readers and the indented passage intended as an instruction to reactor operators. In the opening section, he hedges his criticism in several ways. He assigns agency not to any employee but to the two events in Toledo: "Two recent events at the Toledo site have pointed out . . ." He hedges the implicit accusation that the company is not instructing clients properly by inserting "perhaps" and by referring to "guidance" rather than instruction (one who guides bears less responsibility than one who instructs or orders). Furthermore, he includes himself in the group he accuses of failure; "perhaps *we* are not giving enough guidance . . ." (emphasis added). When he addresses the company's responsibility again in the next paragraph, his hedges are even more elaborate. He does not adopt an assertive voice but merely "wonders" what "guidance, if any" the company should provide. Rather than assert that they should make corrections, he couches his comment as an indirect question. The "if any" here denies the urgency he has just established in the preceding paragraph. His closing is equally mitigated. He disowns the indirect assertion that something must be done by characterizing his memo as a request merely for his readers' "thoughts," and refers to this as a "subject" rather than asserting the more threatening possibility that it is a "problem."

But Kelly's description of the event and the proposed instructions to the reactor operator demonstrate that he is also capable of very direct speech acts. When he describes the event, he is not directing anyone or challenging anyone's competence. The description is direct, agency is clearly marked, and lexical cues such as "as a result" and "even though"

THE BABCOCK & WILCOX COMPANY
POWER GENERATION GROUP

To Distribution

From J.J. Kelly, Plant Integration

Cust. Generic Date November 1, 1977

Subj. Customer Guidance on High Pressure Injection Operation

DISTRIBUTION

B.A. Karrasch
E.W. Swanson
R.J. Finnin
B.M. Dunn
D.W. LaBelle
N.S. Elliott
D.F. Hallman

Two recent events at the Toledo site have pointed out that perhaps we are not giving our customers enough guidance on the operation of the high pressure injection system. On September 24, 1977, after depressurizing due to a stuck open electromatic relief valve, high pressure injection was automatically initiated. The operator stopped HPI when pressurizer level began to recover, without regard to primary pressure. As a result, the transient continued on with boiling in the RCS, etc. In a similar occurrence on October 23, 1977, the operator bypassed high pressure injection to prevent initiation, even though reactor coolant system pressure went below the actuation point.

Since there are accidents which require the continuous operation of the high pressure injection system, I wonder what guidance, if any, we should be giving to our customers on when they can safely shut the system down following an accident? I recommend the following guidelines be sent:

a) Do not bypass or otherwise prevent the actuation of high/low pressure injection under <u>any</u> conditions except a normal, controlled plant shutdown.

b) Once high/low pressure injection is initiated, do not stop it unless: T_{ave} is stable or decreasing <u>and</u> pressurizer level is increasing <u>and</u> primary pressure is at least 1600 PSIG and increasing.

I would appreciate your thoughts on this subject.

JJK: jl

Fig. 12.1. The Kelly memorandum (retyped)

reinforce the description. The indented instructions are even more forceful. The first opens with "Do not," a prohibition, which is one of the strongest possible speech acts. Even the indentation decontextualizes the items and emphasizes their authority. The contrasting styles here are evidence that the pattern of indirection and mitigation in the memo is deter-

MEMORANDUM THE BABCOCK & WILCOX COMPANY

To J.J. Kelly, Plant Integration

From J.F. Walters, Nuclear Service

Cust. TOLEDO Date November 10, 1977

Subj. High Pressure Injection during transient

Ref. Your letter to DISTRIBUTION; Same Subject
Dated NOV 1, 1977.

In talking with training personnel and in the opinion of this writer the operators at Toledo responded in the correct manner considering how they have been trained and the reasons behind this training.

My assumption and the training assumes first that RC Pressure and Pressurizer Level will trend in the same direction under a LOCA. For a small leak they keep the HP system on up to a certain flow to maintain Pressure Level.

In the particular case at Toledo, there was no LOCA of magnitude and with the small leak the inventory in the system came back as expected but due to the recovery of the RCS the RCS pressure cannot respond any quicker than the pressurizer heaters can heat the cold water now pushed back into the pressurizer. Leaving the H.P.I. system on after Pressurizer Level indicator is listed high, will result in the RCS pressure increasing and essentially hydroing the RCS when it becomes solid. If this is the intent of your letter and the thoughts behind it, then the operators are not taught to hydro the RCS everytime the HPI pump is initiated.

If you intend to go solid what about problems with vessel mechanics. Also will the code and electromagnetic valves relief water (via steam) at significant flow rate to keep the RCS from being hydroed.

cc. R.J. FINNIN

Fig. 12.2. The Walters memorandum (retyped; original handwritten)

mined by the difference in power or community affiliation between speaker and hearer. When Kelly addresses other members of the company he exercises considerable tact. When he adopts the authority of the company instructing a client he drops all mitigation and indirection.

If we look at Walters' response, it is clear that he recognizes the criticism implicit in Kelly's memo. Walters, a supervisor in Nuclear Services, openly defends the operators' actions and Nuclear Services' instructions. In the second paragraph, Walters asserts his personal support for the policy

by identifying his position with the policy: "my assumption and the training assumes." At the end of the third paragraph his response ridicules Kelly. In this paragraph, Walters describes a hypothetical chain of events that could follow from Kelly's instructions and argues that Kelly's procedure would lead to "hydroing the RCS when it becomes solid," that is, it would pump dangerously excessive amounts of water into the reactor coolant system (RCS). Even the form of his response is an implied criticism: he says, "If this is the intent of your letter and the thought behind it, then the operators are not taught to hydro the RCS [reactor coolant system] every time the HPI [High Pressure Injection] pump is initiated." This response is doubly critical. By breaking the semantic continuity of the if-then conditional and asserting the obvious—that the operators are not told to overload the system—Walters implies that Kelly's recommendation is not just wrong but absurd. Walters' explicit reference to the "intent and the thoughts behind" the memo announces that he recognizes the criticism implicit in the memo despite Kelly's indirection. In doing so, he not only questions Kelly's knowledge of the training procedures and his right to criticize Nuclear Services' policy, he also underscores the sarcasm in his own response.

This analysis suggests that Walters and Kelly have engaged in a clearly understood, albeit indirect, exchange over their respective responsibilities and competence. Both writers recognize the importance of the technical problem, but it has become part of a negotiation of their social status and their relative institutional positions. One reason why Kelly's memo did not make Nuclear Services rethink its instructions, one reason it "failed," is that Walters may have been too concerned with the public criticism implicit in Kelly's memo, mitigated though it was. He responds to the political threat rather than to the technical problem. The technical disagreement about the safety of the operating instructions is superseded by the concern for public status between members of two different organizational groups.

Although Mathes says that Kelly failed to define his purpose clearly, that he wasn't direct enough, our analysis suggests that Walters thought Kelly was too direct. Because he is an outsider, Kelly presents his memo as an exchange of information rather than as an attempt to influence Nuclear Services' decision making. This social reality limits Kelly's rhetorical options. Mathes' "rational" ideal of management communication would seem to deny that public status and face are negotiated through communication (54). It assumes writers who already know who the decision makers really are (which is not always apparent, even to the decision makers themselves, as Mathes' analysis itself shows), and it assumes recipients who are immune to criticism and threats to their competence and

status. Our pragmatic analysis suggests that this exchange reflects a conflict between social groups rather than flaws in a communication structure. We thus find evidence that discourse reflects not only the existence of social structure but something of the quality of the social relationships it creates. We cannot claim, however, that this causes the participants to misunderstand each other, since they are clearly using the same pragmatic strategies to negotiate their differences. The discourse acknowledges social differentiation but is not itself differentiated.

ARGUMENT ANALYSIS

The argumentative shape of the five Babcock & Wilcox memos provides further information about the nature of their "failure." The analysis below is based on Stephen Toulmin's approach to argument, both on his model for the structure of arguments and on his notion that arguments may be said to belong to a variety of *fields*. According to Toulmin, an argument may be described not so much as a logical or syllogistic structure but as a movement from data (or grounds) to a claim (or conclusion) by means of a warrant, that is, a conceptual connection that is acceptable to those who find the argument sound or convincing. Since the universal standards of logic are not applicable to practical argumentation, according to Toulmin, successful arguments may exhibit considerable variety in the kinds of data, warrants, and claims they use. He accounts for this variety by postulating that arguments belong to "fields." As he develops the notion of field, it includes both cognitive (or semantic) and social dimensions. In *An Introduction to Reasoning*, Toulmin and his coauthors characterize arguments in the fields of law, science, management, arts, and ethics on the basis of what kinds of issues are argued, what kinds of claims are typically made, what kinds of data are offered, and what kinds of reasons (or warrants) are offered as authorizing the connection between data and claim. For example, warrants in science include "mathematical formulas, computer programs, diagrams, graphs, physical models, laws of nature, historical regularities" (250), and those in management primarily focus on profit and survival of the company, although they also include authority, practicality, efficiency, and analogy (301–2). The argument field, therefore, combining as it does sociological and cognitive aspects of argument, serves to connect social structure and language use. It leads us to expect that arguments originating in and used by different social groups will differ and that the differences will be significant, not superficial—that they will indicate different beliefs, commitments, and frameworks of knowledge, which are manifested in differing sorts of data, warrants, and claims.

If we divide the five memos into two groups, three from the Engineering branch (Kelly's memo and the two Dunn memos, figures 12.1, 12.3, and 12.4) and two from the Nuclear Services branch (the Walters and Hallman memos, figures 12.2 and 12.5), we can examine the memos within each branch to see what kinds of claims, data, and warrants are used and whether they are distinct from those of the other branch. Our reading of the five memos suggests that in fact the argumentative structures of the memos from Engineering are more similar to each other than they are to those from Nuclear Services, and vice versa: Engineering seems more willing to consider changes based on analysis of recent events, while Nuclear Services relies on established procedures to minimize changes. The data upon which the Engineering memos rely are the details of the incidents at the Toledo plant, what the operators did and what the consequences were (Kelly, paragraph 1; Dunn 1, paragraph 2). The data in the Nuclear Services memos are circumstances within Babcock & Wilcox itself—the nature of the training provided to operators and the internal difference of opinion about what instructions should be given to operators (Walters, paragraph 2; Hallman, paragraphs 2 and 3). All three of the Engineering memos make essentially the same claim—that the instructions should be changed. The Nuclear Services claims are less univocal, but they are all concerned with organizational procedures within Babcock & Wilcox (the operators responded correctly [Walters, paragraph 1], we're holding up the changes because of our concerns [Hallman, paragraph 4], Plant Integration should resolve the disagreement [Hallman, paragraph 5]). Most interestingly, the warrants, or reasons offered for the claims, indicate different ways of thinking about problems. In the Engineering memos, the warrants are based on generalizations from past facts—that if something has happened in the past it may happen again, and that under changed circumstances it may result in worse consequences. The warrants in the Nuclear Services memos have to do with the dangers of "going solid" (as opposed to the dangers of uncovering the reactor core) and with an unstated understanding about how disagreements within the organization should get resolved.

In general, the arguments from the Engineering branch seem to rely on analysis of new events—the unexpected incidents at the Toledo plant, the actions of the operators during those incidents, and extrapolation to circumstances in which the actions of the operators might have much more serious consequences (it is the fulfillment of this extrapolation in the Three Mile Island accident that makes this series of memos of more than routine interest). In contrast, the arguments from the Nuclear Services branch seem to rely on prior organizational commitments—to the training already given the operators, to the assumption behind the training that "going solid" is

Carl G. Herndl, Barbara A. Fennell, and Carolyn R. Miller

THE BABCOCK & WILCOX COMPANY
POWER GENERATION GROUP

To Jim Taylor, Manager, Licensing

From Bert M. Dunn, Manager, ECCS Analysis (2138)

Cust. Date February 9, 1978

Subj. Operator Interruption of High Pressure Injection

This memo addresses a serious concern with in ECCS Analysis about the potential for operator action to terminate high pressure injection following the initial stage of a LOCA. Successful ECCS operation during small breaks depends on the accumulated reactor coolant system inventory as well as the ECCS injection rate. As such, it is mandatory that full injection flow be maintained from the point of emergency safety features actuation system (ESFAS) actuation until the high pressure injection rate can fully compensate for the reactor heat load. As the injection rate depends on the reactor coolant system pressure, the time at which a compensating match-up occurs is variable and cannot be specified as a fixed number. It is quite possible, for example, that the high pressure injection may successfully match up with all heat sources at time t and that due to system pressurization be inadequate at some later time t2.

The direct concern here rose out of the recent incident at Toledo. During the accident the operator terminated high pressure injection due to an apparent system recovery indicated by high level within the pressurizer. This action would have been acceptable only after the primary system had been in a subcooled state. Analysis of the data from the transient currently indicates that the system was in a two-phase state and as such did not contain sufficient capacity to allow high pressure injection termination. This became evident at some 20 to 30 minutes following termination of injection when the pressurizer level again collapsed and injection had to be reinitiated. During the 20 to 30 minutes of noninjection flow they were continuously losing important fluid inventory even though the pressurizer was at an extremely low power and extremely low burnup. Had this event occurred in a reactor at full power with other than insignificant burnup it is quite possible, perhaps probable, that core uncovery and possible fuel damage would have resulted.

The incident points out that we have not supplied sufficient information to reactor operators in the area of recovery from LOCA. The following rule is based on an attempt to allow termination of high pressure injection only at a time when the reactor coolant system is in a subcooled state and the pressurizer is indicating at least a normal level for small breaks. Such conditions guarantee full system capacity and thus assure that during any follow on transient would be no worse than the initial accident. I, therefore, recommend that operating procedures be written to allow for termination of high pressure injection under the following two conditions only:

1. Low pressure injection has been actuated and is flowing at a rate in excess of the high pressure injection capability and that situation has been stable for a period of time (10 minutes).

2. System pressure has recovered to normal operating pressure (2200 or 2250 psig) and system temperature within the hot leg is less than or equal to the normal operating condition (605 F or 630 F).

I believe this is a very serious matter and deserves our prompt attention and correction.

BMD/lc

cc: E.W. Swanson
D.H. Roy
B.A. Karrasch
H.A. Bailey
J. Kelly
E.R. Kane
J.D. Agar
R.L. Pittman
J.D. Phinny
T. Scott

Fig. 12.3. The first Dunn memorandum (retyped 2 pages)

the most serious potential effect of the types of reactor incidents under discussion, to existing organizational procedures for resolving disputes. Nuclear Services, in a word, is committed to the *maintenance* of an interpretive framework, a framework that it is responsible for disseminating to customers and operators. Engineering is committed to the *explanation* of new data that do not fit the existing interpretive framework.

The difference between these two sets of commitments reflects the difference between the two social groups involved: not only does the formal structure of the organization correspond to the different argumentative commitments, but the differences in argument are consistent with the different organizational functions of the two groups. The differentiated social relations and tasks of the two branches may in fact lead to differentiated conceptual frameworks—sets of shared beliefs, concepts, and purposes that reflect and enhance the social differences. Such differences do not, of course, make the discourse of the two branches mutually incomprehensible, but they do make arguments difficult to resolve. Such differences seem to us likely to have contributed to the failure of communication at Babcock & Wilcox.

Our three analyses of the substance of this communication supplement the procedural perspective of traditional organizational communication studies. Linguistic analysis shows that the failure is not a matter of the basic competence of the writers. Pragmatic analysis demonstrates that Kelly's indirection is not a failure but a consequence of the social context within which he functions. And argument analysis suggests that there are important differences in the ways social groups define problems and construct arguments. Even with ideal communication environment and pro-

THE BABCOCK & WILCOX COMPANY
POWER GENERATION GROUP

To Jim Taylor, Manager, Licensing

From Bert M. Dunn, Manager, ECCS Analysis (2138)

Cust. Date February 16, 1978

Subj. Operator Interruption of High Pressure Injection

In review of my earlier memo on this subject, dated February 9, 1978, Field Service has recommended the following procedure for terminating high pressure injection following a LOCA.

1. Low pressure injection has been actuated and is flowing at a rate in excess of the high pressure injection capability and that situation has been stable for a period of time (10 minutes). Same as previously stated.

2. At X minutes following the initiation of high pressure injection, termination is allowed provided the hot leg temperature indication plus appropriate instrument error is more than 50 F below the saturation temperature corresponding to the reactor coolant system pressure less instrument error. X is a time lag to prevent the termination of the high pressure injection immediately following its initiation. It requires further work to define its specific value, but it is probable that 10 minutes will be adequate. The need for the delay is that normal operating conditions are within the above criteria and thus it is conceivable that the high pressure injection would be terminated during the initial phase of a small LOCA.

I find that this scheme is acceptable from the standpoint of preventing adverse long range problems and is easier to implement. Therefore, I wish to modify the procedure requested in my first memo to the one identified here.

cc: E.W. Swanson
D.H. Roy
B.A. Karrasch
H.A. Bailey
J. Kelly
E.R. Kane
J.D. Agar
R.L. Pittman
J.D. Phinny
T. Scott

Fig. 12.4. The second Dunn memorandum (retyped)

cedures, these substantive differences can make it difficult for members of one group to persuade members of another. However, we do not want to press the significance of this single case too far. We recognize that thorough ethnographic data might expand this analysis and elaborate our sketch of the differentiation of discourse among social groups, but this

BABCOCK & WILCOX COMPANY
POWER GENERATION GROUP

cc: E.R. Kane
J.D. Phinney
B.W. Street
B.M. Dunn
J.F. Walters

To B.A. Karrasch, Manager, Plant Integration

From D.F. Hallman, Manager, Plant Performance Services

Cust. Date August 3, 1978

Subj. Operator Interruption of High Pressure Injection (HPI)

References: (1) B.M. Dunn to J. Taylor, same subject, Feb. 9, 1978
(2) B.M. Dunn to J. Taylor, same subject, Feb. 16, 1978

References 1 and 2 (attached) recommend a change in B&W's philosophy for HPI system use during low-pressure transients. Basically, they recommend leaving the HPI pumps on, once HPI has been initiated, until it can be determined that the hot leg temperature is more than 50 F below T_{sat} for the RCS pressure.

Nuclear Service believes this mode can cause the RCS (including the pressurizer) to go solid. The pressurizer reliefs will lift, with a water surge through the discharge piping into the quench tank.

We believe the following incidents should be evaluated:

1. If the pressurizer goes solid with one or more HPI pumps continuing to operate, would there be a pressure spike before the reliefs open which could cause damage to the RCS?

2. What damage would the water surge through the relief valve discharge piping and quench tanks cause?

To date, Nuclear Service has not notified our operating plants to change HPI policy consistent with References 1 and 2 because of our above-stated questions. Yet, the references suggest the possibility of uncovering the core if present HPI policy is continued.

We request that Integration resolve the issue of how the HPI system should be used. We are available to help as needed.

D.F. Hallman

DFH/feh
Attachments

Fig. 12.5. The Hallman memorandum (retyped)

material is not available. Thus, our conclusions here must be taken as suggestive. In the next section we attempt to reinforce them by adapting our methods to the analysis of another communication failure.

Communication Failure and the Challenger Accident

The Presidential Commission that investigated the explosion of the space shuttle Challenger in January 1986 published a five-volume report that includes transcripts of the hearings it conducted and copies of many documents from NASA and Morton Thiokol. While this is a rich body of data, it has two weaknesses for our purposes: first, among the written texts made available there are no continued, focused interactions between groups or organizations about a single issue (like the Babcock & Wilcox memos); and second, all the oral interactions are recollected under questioning, sometimes many months after the fact. Nonetheless, this material does benefit from an analysis that builds on our conclusions from the Three Mile Island material. In both of the incidents we discuss below, argument analysis of the substantive elements of discourse – warrants and evidence – describes one way in which discourse reflects social differentiation within organizations and explains how such differences limit the ability of writers and speakers to communicate and direct decision making.

The first incident we take up involves a pair of memos written at NASA headquarters; they were prepared independently, in two different offices, but at roughly the same time, the July before the accident. Both reacted to the growing awareness at NASA that the "O-ring" seals in the solid rocket motors manufactured by Morton Thiokol in Utah were occasionally eroding during flight. (These memos are reproduced in figures 12.6 and 12.7.) The first memo was written by Richard Cook, a budget analyst at NASA's Washington headquarters, who had been at NASA only a few weeks. The second was written by Irving Davids, an engineer with the Shuttle Propulsion Division at NASA headquarters, who had been at NASA for 35 years. A formal linguistic analysis of the Cook and Davids memos reveals little evidence of deviation from standard written language. There are minor differences on the lexical, morphological, orthographic, and syntactic levels, but they do not interfere with readers' comprehension of the memos.

An analysis of the argument structure of these memos at first shows no clear differences between the writers. Both claim that the O-rings are a major problem, both locate their grounds in the writer's discussion with engineers, and both rely on the warrant that engineers are qualified to speak on this topic. But despite their similar argument structures, these memos appear to have been received quite differently, judging by the way NASA managers described Cook and Davids at the Rogers Commission hearings. Cook is described by a Deputy Associate Administrator at NASA

MEMORANDUM 7/23/85

TO: BRC/M. Mann

FROM: BRC/R. Cook

SUBJECT: Problem with SRB Seals

Earlier this week you asked me to investigate reported problems with the charring of seals between SRB motor segments during flight operations. Discussions with program engineers show this to be a potentially major problem affecting both flight safety and program costs.

Presently three seals between SRB segments use double O-rings sealed with putty. In recent Shuttle flights, charring of these rings has occurred. The O-rings are designed so that if one fails, the other will hold against the pressure of firing. However, at least in the joint between the nozzle and the aft segment, not only has the first O-ring been destroyed, but the second has been partially eaten away.

Engineers have not yet determined the cause of the problem. Candidates include the use of a new type of putty (the putty formerly in use was removed from the market by EPA because it contained asbestos), failure of the second ring to slip into the groove which must engage it for it to work properly, or new, and as yet unidentified, assembly procedures at Thiokol. MSC is trying to identify the cause of the problem, including on-site investigation at Thiokol, and OSF hopes to have some results from their analysis within 30 days. There is little question, however, that flight safety has been and is still being compromised by potential failure of the seals, and it is acknowledged that failure during launch would certainly be catastrophic. There is also indication that staff personnel knew of this problem sometime in advance of management's becoming apprised of what was going on.

The potential impact of the problem depends on the as yet undiscovered cause. If the cause is minor, there would be little or no impact on budget or flight rate. A worse case scenario, however, would lead to the suspension of Shuttle flights, redesign of the SRB, and scrapping of existing stockpiled hardware. The impact on the FY 1987-8 budget could be immense.

It should be pointed out that Code M management is viewing the situation with the utmost seriousness. From a budgetary standpoint, I would think that any NASA budget submitted this year for FY 1987 and beyond should certainly be based on a reliable judgment as to the cause of the SRB seal problem and a corresponding decision as to budgetary action needed to provide for its solution.

Richard C. Cook
Program Analyst

Michael B. Mann
Chief, STS Resources Analysis Branch

Gary B. Allison
Director, Resources Analysis Division

Tom Newman
Comptroller

Fig. 12.6. The Cook memorandum. Reproduced from Presidential Commission 4: 391–92

NASA
National Aeronautics and
Space Administration

Washington, D.C.
20646

Jul 17 1985

MPS.

TO: M/Associate Administrator for Space Flight

FROM: MPS/Irv Davids

SUBJECT: Case to Case and Nozzle to Case "O" Ring Seal Erosion Problems

As a result of the problems being incurred during flight on both case to case and nozzle to case "O" ring erosion, Mr. Hamby and I visited MSFC on July 11, 1985, to discuss this issue with both project and S&E personnel. Following are some important factors concerning these problems:

A. Nozzle to Case "O" ring erosion
There have been twelve (12) instances during flight where there have been some primary "O" ring erosion. In one specific case there was also erosion of the secondary "O" ring seal. There were two (2) primary "O" ring seals that were heat affected (no erosion) and two (2) cases in which soot blew by the primary seals.

The prime suspect as the cause for the erosion on the primary "O" ring seals is the type of putty used. It is Thiokol's position that during assembly, leak check, or ignition, a hole can be formed through the putty which initiates "O" ring erosion due to a jetting effect. It is important to note that after STS-10, the manufacturer of the putty went out of business and a new putty manufacturer was contracted. The new putty is believed to be more susceptible to environmental effects such as moisture which makes the putty more tacky.

There are various options being considered such as removal of putty, varying the putty configuration to prevent the jetting effect, use of a putty made by a Canadian Manufacturer which includes asbestos, and various combinations of putty and grease. Thermal analysis and/or tests are underway to assess these options.

Thiokol is seriously considering the deletion of putty on the QM-S nozzle/case joint since they believe the putty is the prime cause of the erosion. A decision on this change is planned to be made this week. I have reservations about doing it, considering the significance of the QM-S firing in qualifying the FWC for flight.

It is important to note that the cause and effect of the putty varies. There are some MSFC personnel who are not convinced that the holes in the putty are the source of the problem but feel that it may be a reverse effect in that the hot gases may be leaking through the seal and causing the hole track in the putty.

Considering the fact that there doesn't appear to be a validated resolution as to the effect of the putty, I would certainly question the wisdom of removing it on QM-S.

B. Case to Case "O" Ring Erosion

There have been five (5) occurrences during flight where there was primary field joint "O" ring erosion. There was one case where the secondary "O" ring was heat affected with no erosion. The erosion with the field joint primary "O" rings is considered by some to be more critical than the nozzle joint due to the fact that during the pressure build up on the primary "O" ring the unpressurized field joint secondary seal unseats due to joint rotation.

The problem with the unseating of the secondary "O" ring during the joint rotation has been known for quite some time. In order to eliminate this problem on the FWC field joints a capture feature was designed which prevents the secondary seal from lifting off. During our discussions on this issue with MSFC, an action was assigned for them to identify the timing associated with the unseating of the secondary "O" ring and the seating of the primary "O" ring during rotation. How long it takes the secondary "O" ring to lift off during rotation and when in the pressure cycle it lifts are key factors in the determination of its criticality.

The present consensus is that if the primary "O" ring seats during ignition, and subsequently fails, the unseated secondary "O" ring will not serve its intended purpose as a redundant seal. However, redundancy does exist during the ignition cycle, which is the most critical time.

It is recommended that we arrange for MSFC to provide an overall briefing to you on the SRM "O" rings, including failure history, current status, and options for correcting the problems.

Irving Davids

cc:
M/Mr. Weeks
M/Mr. Hamby
ML/Mr. Harrington
MP/Mr. Winterhalter

Fig. 12.7. The Davids memorandum.
Reproduced from the Presidential Commission 1: 248

as "not too knowledgeable," a "young chap," "picking up things in the hallway," a "financial type person" (4:250); his memo is characterized as a "training letter" (4:398). Davids is described as "very senior and very careful," someone "who I guess we gave him his 35-year pin some time ago" (4:250). The warrant that makes the difference here is supplied by the relationship between the readers and the writer; it is the warrant of the writer's standing within the community (related to the rhetorical concept of *ethos*). In this respect, argument and pragmatic analyses are related, since both can attend to the interaction of writers and readers and specifically to questions of relative status. Cook's memo itself betrays his status as a newcomer in several ways: the lack of detailed data and quantified budget estimates, the use of nontechnical language ("eaten away" for *eroded*, "if one fails the other will hold" for *redundancy*), the lack of subheads, the mention of safety concerns in a budget memo (this last

transgression was the subject of intense questioning by Commission Chairman Rogers and others). Cook's status as something of an outsider, a "discourse-learner," is confirmed by the fact that his memo is far more comprehensible to other outsiders (such as we are) than is Davids' memo.

Our belief that there is a warrant generated by Cook's standing within the community is similar to Mathes' claim that Kelly's position within Babcock & Wilcox contributed to the miscommunication at Three Mile Island. Mathes had questioned Kelly's decision to sign his memo on the grounds of his status within the organization. Our discussion of the Cook memo goes beyond this analysis, however, in that it isolates the textual expression of his position in the social order at NASA. Cook's position as a discourse learner leads him to construct a text which seemed to communicate to NASA management his status as a newcomer more forcefully than it communicated his concern over the O-ring issue itself. As before, argument analysis articulates the relation between the discourse and the quality of social relations.

The second incident from the Challenger material is the teleconference at which the decision to approve the launch was made the evening before the accident. It was convened at the request of the Morton Thiokol representative at NASA's Marshall Space Flight Center, who was worried that the weather was too cold to launch the shuttle safely. The teleconference participants included personnel from Morton Thiokol in Utah, NASA's Marshall Center in Alabama, and Kennedy Space Center in Florida. Some were high-level managers concerned with scheduling and making launch decisions, and some were line engineers directly responsible for designing and testing the O-ring seals. The conference lasted over two hours; after the first hour and a half, when Morton Thiokol managers were recommending a delay of the launch, NASA officials requested that Morton Thiokol reconsider their recommendation. The Morton Thiokol group then requested an off-line "caucus," which was intended to last about five minutes but which went on for about thirty. During the caucus, the engineers and managers at MTI debated whether the low temperatures in Florida would interfere with the operation of the O-ring seals. Finally, the vice-president for the booster program telefaxed to NASA a summary of the discussion with a recommendation to proceed with the launch. The debate at MTI, between engineering and management, resulted in a changed decision by management and the telefax stating and explaining that decision (figure 12.8).

The differences between management and engineering were apparent and significant to participants in the caucus as their testimony before the Rogers Commission shows. The engineers argued from extensive experience in handling the failed parts, while management argued from experi-

MTI ASSESSMENT OF TEMPERATURE CONCERN ON SRM-25 (51L) LAUNCH

- 0 CALCULATIONS SHOW THAT SRM-25 O-RINGS WILL BE 20° COLDER THAN SRM-15 O-RINGS
- 0 TEMPERATURE DATA NOT CONCLUSIVE ON PREDICTING PRIMARY O-RING BLOW-BY
- 0 ENGINEERING ASSESSMENT IS THAT:
  - 0 COLDER O-RINGS WILL HAVE INCREASED EFFECTIVE DUROMETER ("HARDER")
  - 0 "HARDER" O-RINGS WILL TAKE LONGER TO "SEAT"
    - 0 MORE GAS MAY PASS PRIMARY O-RING BEFORE THE PRIMARY SEAL SEATS (RELATIVE TO SRM-15)
      - 0 DEMONSTRATED SEALING THRESHOLD IS 3 TIMES GREATER THAN 0.038" EROSION EXPERIENCED ON SRM-15
  - 0 IF THE PRIMARY SEAL DOES NOT SEAT, THE SECONDARY SEAL WILL SEAT
    - 0 PRESSURE WILL GET TO SECONDARY SEAL BEFORE THE METAL PARTS ROTATE
      - 0 O-RING PRESSURE LEAK CHECK PLACES SECONDARY SEAL IN OUTBOARD POSITION WHICH MINIMIZES SEALING TIME
- 0 MTI RECOMMENDS STS-51L LAUNCH PROCEED ON 28 JANUARY 1986
  - 0 SRM-25 WILL NOT BE SIGNIFICANTLY DIFFERENT FROM SRM-15

JOE C. KILMINSTER, VICE PRESIDENT
SPACE BOOSTER PROGRAMS

MORTON THIOKOL INC.
Wasatch Division

INFORMATION ON THIS PAGE WAS PREPARED TO SUPPORT AN ORAL PRESENTATION AND CANNOT BE CONSIDERED COMPLETE WITHOUT THE ORAL DISCUSSION

Fig. 12.8. The Morton Thiokol telefax.
Reproduced from Presidential Commission 4: 753

ence with flight records and program needs. During the caucus, the senior manager on the MTI end of the teleconference, Mason, told Lund, the vice-president of Engineering, to "take off his engineering hat and put on his management hat" (4:772). After much discussion, Mason conducted a poll to decide whether to change the recommendation, but he polled only management people because he knew what the opinions of the engineers were (4:765). Under commission questioning, it became apparent that the two top engineering experts disagreed with the management decision. But Mason's belief was that in the absence of conclusive engineering data, a judgment was needed and that managers were the people who make judgments (4:773).

Roger Boisjoly, the top engineering expert on the seals, argued strenuously against the management decision throughout the thirty-minute

caucus and noted in a log made after the caucus but before the launch that "the data does exist to lead us to our engineering recommendation." He also wrote, "our management [made] the decision that it was a low risk based upon *their* assumption that temperature was not a discriminator." (He also wrote, "I sincerely hope that this launch does not result in a catastrophy [sic]" [4:684]). At one point late in the caucus, Boisjoly made a final attempt to change the minds of his managers: as he told the commission, "I tried one more time. . . . I went up and discussed the photos once again and tried to make the point that it was my opinion from actual observations that temperature was a discriminator. . . . I also stopped when it was apparent that I couldn't get anybody to listen" (4:793). He seems then to have realized that what he considered to be argumentatively compelling was quite different from what the managers would believe.

The telefax claims that the launch should proceed and warrants this claim with the statement that the launch will not be significantly different from a previous launch that had both the coldest temperature and the most charring and erosion of O-rings. The discussion had centered on just this point, what the effect would be of the expected temperature, twenty degrees colder than any previous flight. The grounds of the telefax include the statement that the temperature data are "not conclusive." Although Boisjoly couldn't "conclusively demonstrate the tie-in between temperature and blow-by [charring]" (4:675–76), he argued from his own first-hand knowledge gained in examining the physical evidence recovered from previous flights. But in the absence of what they considered to be "hard" engineering data about the future, the managers reasoned on the basis of "the only conclusive data" they had, "flight data," that is, data about past experience with shuttle launches (4:616). As Richard Feynman, one of the commission members, put it, the assumption grew that "we can lower our standards a little bit because we got away with it last time. . . . an argument is always given that the last time it worked" (5:1446). Both engineers and management were using warrants from past experience, but the nature of the experience that convinced them was different. Boisjoly reasoned from *causes* at the level of physical detail—charring and erosion of O-rings. The managers reasoned from *results* at the level of contracts and programs—successful flights. The warrants of each set of interests, or social group, were insufficient to the other. Again, as at Babcock & Wilcox, the differences between them reflect the professional experiences and commitments of the two groups.

As Gouran et al. have concluded, the structural factors involved in NASA's decision procedures appear impeccable; they attribute the erroneous decision to the "social, psychological, and communicative environment" (133), including "perceived pressure" from NASA and "unwillingness . . . to violate perceived role boundaries" (121). Our analysis suggests

that the common view that managers at Morton Thiokol were just acquiescing to pressure from NASA is too simple. Rather, it may be that engineers and managers were unable, more than unwilling, to recognize data which deviated from that characteristic of their organizational roles. Different experiences and commitments provided the engineers and managers with different understandings of the problem and with different argumentative resources. These differences manifest themselves in the different warrants and evidence offered by members of each group.

Conclusion

Our analyses of the communication failures associated with the Three Mile Island and Challenger accidents suggest three conclusions for the study of organizational discourse. First, in confirming the theoretical notion that social differentiation often creates differentiated discourse we are led to distinguish two kinds of communication failure, which we have called *miscommunication* and *misunderstanding*. Miscommunication is detected through structural analysis and is due to the lack of a common language or to faulty communication procedures within an organization. Misunderstanding is detected through substantive analysis of what people say or write and what they must share to interpret discourse as it was intended. Put simply, miscommunication revolves around the *how* of communication, while misunderstanding revolves around the *what*. In linguistics this distinction is analogous to the distinction between the formal and social dimensions of language, in organizational communication to quantitative and interpretive research, in argument to logical and substantive analysis. Work in all these disciplines has moved away from formal toward substantive analysis, creating, for one thing, a closer connection between linguistics and rhetoric. We found here that substantive analysis provided richer explication of the communication problems we were exploring.

Second, the conjunction of multiple analyses here raises another question of method. Beyond the critical commonplace that research generally discovers the kind of data suited to the research methodology, we would point out that analytic models describe groups at characteristic levels of generality or specificity. The three methods we have employed describe three levels of groups. Formal linguistic analysis seems to identify groups at the general level of all potentially competent speakers of the language. It might, for example, distinguish very large groups by noting semantic and syntactic differences between different languages or dialects. This suggests that its utility in exploring organizational discourse is largely restricted to discounting explanations based on speakers' fluency or grammatical

competence. Pragmatic analysis operates on a somewhat smaller scale, since pragmatic awareness comes late in language acquisition and is closely tied to social context. We suspect that it will distinguish the discourse of social groups at the level of large cultural institutions (as in Agar's work on institutional discourse). In more localized studies such as ours, it seems most useful in reflecting writers' perceptions of social context and group affiliation. It provides a way of determining the boundaries between social groups as they are actually perceived by the group members rather than as they appear on an organizational chart. It does so, however, only because writers like Kelly and Walters employ the same pragmatic standards to negotiate their social agendas. It doesn't differentiate the discourse of these groups at this level.

Argument analysis seems the best suited to identify groups within large organizations such as Morton Thiokol and Babcock & Wilcox and to describe the way the discourse of such groups differs. Its power comes from the fact that it reveals the substantive differences in discourse. It shows how discourse reflects the knowledge possessed by groups and how this knowledge is constructed and deployed. We suspect that research in organizational discourse will progress by employing similar analytic methods that focus on questions of social knowledge and describe the substance rather than the structure or process of communication.

Finally, we believe that our work illustrates the complexity of the current term "discourse community." Since the relationships between language use and social structure are various and are describable with different analytic methods, the term discourse community becomes either misleadingly vague or intriguingly rich. It is also subject to a troublesome circularity, in which the community is defined by the discourse and vice versa. This theoretical difficulty may best be handled by careful attention to the limitations and capacities of research methods. The term discourse community may then be most useful as an umbrella term that incorporates speech community, interpretive community, argument field, and the like. Our work here begins to suggest how all these terms might be related, how they can inform each other, and how empirical studies can help clarify theory.

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