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*At the urging of managers from NASA's Marshall Space Flight Center on the night before the fatal launch of the* Challenger*, the managers at Thiokol reconsidered their judgment not to launch the next day. Although there were no new data, and although their engineers still objected, the Thiokol managers took off their "engineering hats" and put on their "management hats" and decided to launch anyway. The urging of Marshall management and pressure from other sources intimidated Thiokol management and at least one Marshall engineer to do what their superiors wanted them to do. Four conditions created the intimidation: (a) a fear of retaliation, (b) a lack of justice, (c) Marshall's tradition of discouraging the reporting of bad news, and (d) an objectionable act, that is, overruling the engineers on a life or death technical decision.*

# Intimidation and Communication
## A Case Study of the *Challenger* Accident

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On the night before the *Challenger* accident, NASA and Morton Thiokol engineers and managers gathered at three sites, Brigham City, Utah; Huntsville, Alabama; and Kennedy Space Center in Florida, for a fateful teleconference. At the end of the teleconference late in the night of January 27, 1986, Ben Powers, NASA's expert on O-rings at Huntsville, went home very worried. Powers said this in an unpublished interview with the Presidential Commission on the Space Shuttle *Challenger* Accident:

> I went home and I was concerned. And the more I thought about it, the worse I felt about it. And I went home and I made a statement to my wife that I was very concerned that the shuttle would fail. And she has reminded me of that, and I've never done that before. I've never been in a situation where I felt like that.
>
> And she says I didn't sleep any that night, that I was grinding my teeth, she said, all night long, and tossing and turning. I really remember I didn't sleep much.
>
> And I come in the next morning, and the fellows in the office would verify this, that I mentioned to them that I was very concerned that the solid rocket motor would fail.
>
> . . . [A]nd when it exploded I knew why. (34-36)

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At the meeting the night before the launch, Powers had agreed with the Morton Thiokol engineers in Utah that it would be too cold to launch on the morning of January 28, 1986. He had given his opinion to his immediate superior at the meeting in Huntsville, but he had said nothing about his reservations to the most senior manager, George Hardy, who was directing the meeting and sitting a few feet away.

Near the end of the teleconference, after the Morton Thiokol managers had overruled their engineers in Utah and approved the launch, George Hardy looked around the room at the meeting participants in Huntsville and asked them, including Ben Powers, if they had anything to add. When asked by the Presidential Commission interviewer if he wanted to say something at that point, Powers said, "It's just useless. You know it's useless, so you just don't" (28). Then the interviewer asked, "Why would you know it's useless?" Powers answered:

> Once the contractor has said, hey, I'm reversing my position, you know, I took my data and threw it in the trash can and I'm ready to go, I'm ready to fly, then you're pretty well committed.
>
> Now in retrospect, you know, the way I look at what I did, why I did it, and I'm not at all happy with what I did, I did not know that Thiokol was going to reverse themselves. If I knew they were going to reverse themselves, then I would have been really trying to twist some arms. . . .
>
> And if I look back on it now, what I should have done is I should have done everything within my power to get it stopped. I should have taken over the meeting and all that. But, you know, really I'm not of that grade structure or anything. (28-29)

My argument in this article is that one of the chief contributing causes of the *Challenger* accident was intimidation, or pressure. Some of the engineers and managers involved the night of January 27, 1986, in the decision to launch were afraid to oppose the launch. Many people have said that the cause of the *Challenger* accident was pressure. In the hearings held by the United States House of Representatives Committee on Science and Technology, Representative Jan Myers from Kansas said that "if there is a villain in this, it seems to me that pressure is the villain" (United States, *Hearings* 1: 71). Articles by Winsor; Moore; and Gouran, Hirokawa, and Martz also discuss the effects of pressure on the decisions surrounding the launch of the *Challenger*.

Because the sources of intimidation are so widely distributed—Congress, the press, several United States Presidents—I shall focus



mainly on one: NASA's Marshall Space Flight Center in Huntsville, Alabama. Marshall was singled out repeatedly for blame in the investigations after the *Challenger* accident. When the Presidential Commission presented their findings to the American public, they specifically named Marshall as the source of the pressure:

> The Commission concluded that the Thiokol Management reversed its position and recommended the launch of 51-L [i.e., the *Challenger*], at the urging of Marshall and contrary to the views of its engineers in order to accommodate a major customer. (United States, *Report* 1: 104)

The "major customer" was Marshall Space Flight Center, which supervised Thiokol's contract for the solid rocket boosters. Even former top NASA officials put much of the blame on Marshall:

> Competition between NASA's main space centers also is blamed for the lack of communication, which current and former top NASA officials say fostered suspiciousness that kept other parts of the agency from learning about shuttle problems.
>
> The worst offender, the officials say, was Marshall Space Flight Center, which oversaw the boosters. (Fisher A5)[1]

Presidential Commission members were especially bothered with "the 'unrepentant' attitude of Marshall managers." One Presidential Commission member referred to the Marshall managers as "arrogant bastards" (Smart and Reidy A4).

Although I will focus on Marshall and its relationship with its own employees and with its contractor, Thiokol, I want to reemphasize that the blame for the *Challenger* accident and for the pressure is shared by many other organizations and individuals. In fact, if Marshall had been the only problem, then the engineers who complained about the O-rings and the low temperatures could have easily gotten around Marshall's management and appealed to other sources for help. Unfortunately, because the pressure to launch was so widely distributed, there were no other sources of help.

## THE NIGHT BEFORE THE LAUNCH

The pressure came to a head in the afternoon and evening of Monday, January 27, and the early morning hours of Tuesday, January 28. Here is an outline of what happened that night.

Around 4:00 p.m. on Monday, January 27, Bob Ebling, Thiokol's manager of the ignition system and final assembly of the solid rocket

booster project, called Allan McDonald, Thiokol's director of the solid rocket booster project, at Kennedy Space Center to discuss the cold weather (18° F) that was predicted for Kennedy and to discuss the effect of the weather on the O-rings. McDonald became alarmed and called Thiokol's manager at Kennedy to tell him about his concerns about the cold weather. A teleconference that was scheduled for 6:15 p.m. broke up because of electronic and connection difficulties. A second teleconference (via telephone speakers) at 8:15 p.m. eastern standard time included participants from Marshall and Thiokol at three sites: Kennedy Space Center (KSC); Marshall in Huntsville, Alabama; and the Thiokol Wasatch division in Utah. The participants gathered detailed engineering data and charts and transmitted them by fax so everyone could discuss the situation.

According to the Presidential Commission Report, a total of 34 people from Marshall and Thiokol participated in the teleconference (United States, *Report* 1: 111). Figure 1 lists the key people who will be discussed in this article, their affiliations (either Marshall or Thiokol), and the site where they participated in the teleconference on the night of January 27, 1986.

Thiokol went through a detailed presentation that tried to show that the O-rings would not work properly at low temperatures. They said that the O-ring temperature must be equal to or greater than 53° at launch. At the conclusion of Thiokol's presentation, Thiokol manager Robert Lund recommended that NASA not launch until the temperature warmed up to 53° F.

According to the Presidential Commission data, Marshall engineering managers reacted strongly to Thiokol's line of reasoning and its recommendation not to launch. Lawrence Mulloy, a Marshall manager who was at Kennedy only for the launch, said, "My God, Thiokol, when do you want me to launch, next April?" (United States, *Report* 5: 843), and George Hardy said he was "appalled" at Thiokol's recommendation (1: 107). Allan McDonald of Thiokol was with Lawrence Mulloy in Florida, and he said in an unpublished interview with the Presidential Commission that "Mulloy in my opinion used a very heavy hand in the [statement] he made about when you would expect a launch in April" (14).

Ben Powers of NASA attended the meeting with Hardy at Marshall. In an unpublished interview, a Presidential Commission interviewer, Raymond Molesworth, asked Powers, "How was Mr. Hardy's initial reaction to the no-launch decision from Thiokol?" Powers responded:

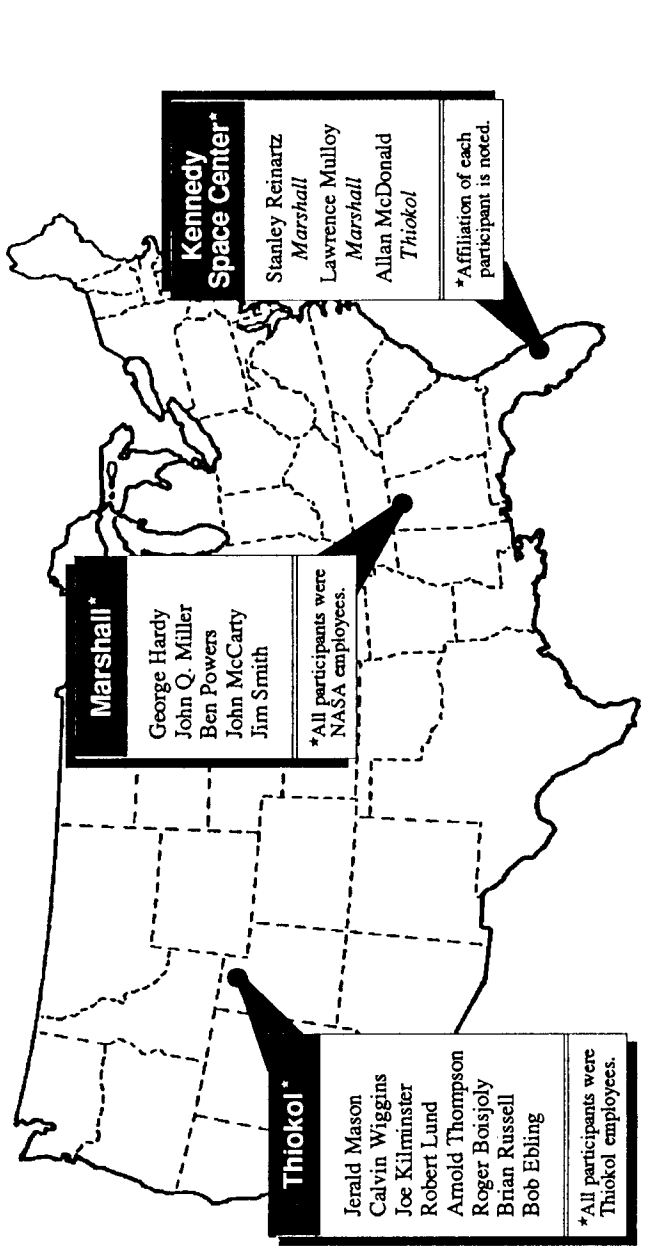


**Figure 1. Key Participants in the Final Teleconference**
SOURCE: *Report of the Presidential Commission*, Vol. 1, p. 111.

Powers: . . . Now he was really wringing them out.
Molesworth: Taking a pretty strong—
Powers: Oh, boy, he was really asking them questions. He had his sleeves rolled up and his jaw set hard, and he was examining that data, boy, every line of it, you know. How do you know this and how do you know that? And getting the contractor to defend every cottonpicking argument he had the best he could.

And the reason for that is, is [sic] he tells his boss he's going to stop the launch, you know, then he has to understand why he's stopping the launch. . . . [S]topping a launch is not an easy thing. You know, there's a lot of people committed to launching. (17-18)

Later in the interview when asked, "Did you hear Hardy or someone say to the Thiokol people he was appalled at their recommendation, the no-launch recommendation?" Powers answered as follows:

I can't—right now my memory's kind of bothering me: . . . I can't say for sure.

You know, he [Hardy] was really rolling up his sleeves and working hard and vigorously to challenge every aspect of their data to make sure that he was in agreement with it. That would be, I would think, indicative that he was really appalled, you know, because he was working real hard to make sure that they had a sound data base for what they were recommending. . . .

. . . However, I think this probably may have been a little more vigorous from Hardy than what you would normally see. He was really probing the data hard. There was vigor in it. You know, I don't want to minimize what he was doing. To tell the truth as best I can, he was working vigorously to understand every detail of their data.

And that can be interpreted on the Thiokol side as, you know, the guy is really pushing. And, of course, Hardy's not looking at it that way at all. He's looking at it like, you know, I'm going to get to the bottom of this recommendation. (32-33)

Thiokol's Robert Lund also told the Presidential Commission how Marshall managers Lawrence Mulloy and George Hardy reacted to Thiokol's recommendation that night not to launch.

There was no real extensive erosion of that O-ring [at 53° F], so it wasn't a major concern, but we said, gee, you know, we just don't know how much further we can go below the 51 or 53 degrees or whatever it was. So we were concerned with the unknown. And we presented that to Marshall, and that rationale was rejected. They said that they didn't accept that rationale, and they would like us to consider some other thoughts that they had had. . . .

. . . And he [Mulloy] presented a very strong and forthright rationale of what they thought was going on in that joint and how they thought



that the thing was happening, and they said, we'd like you to consider that when they had some thoughts that we had not considered. (United States, *Report* 1: 94)

One of the Presidential Commission staff interviewers also asked Thiokol senior vice president Jerald Mason how Hardy reacted to the decision not to launch. Mason said, "Oh, yes, it was over and over. Hardy said that, 'I'm appalled at your recommendation' " (United States, *Report* 1: 94).

After the Marshall managers reacted strongly against Thiokol's recommendation to not launch, Thiokol manager Joe Kilminster in Utah asked for a break, off-line, so that the Thiokol managers and engineers could discuss the matter. Engineer Roger Boisjoly and engineering manager Arnold Thompson tried to support their decision not to launch. Boisjoly also tried to persuade the Thiokol managers once again by using photographs. But he told the Presidential Commission that he "stopped when it was apparent that I couldn't get anybody to listen" (United States, *Report* 1: 92). Then Boisjoly told the Presidential Commission how the Thiokol managers handled the problem:

After Arnie [Thompson] and I had our last say, Mr. Mason said we have to make a management decision. He turned to Bob Lund and asked him to take off his engineering hat and put on his management hat. From this point on, management formulated the points to base their decision on. There was never one comment in favor, as I have said, of launching by any engineer or other nonmanagement person in the room before or after the caucus. (1: 92-93)

Boisjoly was asked by Arthur Walker, Jr., one of the Presidential Commission members, about the source of the pressure on the Thiokol management:

Walker: Do you know the source of the pressure on management that you alluded to?
Boisjoly: Well, the comments made over the [teleconference net] is what I felt, I can't speak for them, but I felt it—I felt the tone of the meeting exactly as I summed up, that we were being put in a position to prove that we should not launch rather than being put in the position and prove that we had enough data to launch. And I felt that very real.
Walker: These were the comments from the NASA people at Marshall and at Kennedy Space Center?
Boisjoly: Yes. (United States, *Report* 1: 93)

After the off-line discussion, which lasted 30 minutes or so, the teleconference started up again, but Thiokol's recommendation had changed. Thiokol managers, responding to the pressure, now said that they were still worried about the cold, but thought that perhaps the data were inconclusive after all. The Thiokol managers concluded that there would still be a safety margin, and so Kilminster wrote a telefax message to Kennedy and Marshall: "MTI [Thiokol] recommends STS-51L [the *Challenger*] launch proceed on 28 January 1986" (United States, *Report*, 1: 97). Ben Powers told the Presidential Commission in an unpublished interview that when he heard that Thiokol had reversed its decision, "I couldn't believe it" (28).

## SILENCE, ORGANIZATIONAL ROLES, AND POLITICS

This article is, to some extent, speculative. Many people in organizations become secretive after a fatal accident. As Sissela Bok has said,

> Conflicts over secrecy . . . are conflicts over power: the power that comes through controlling the flow of information. . . . To have no capacity for secrecy is to be out of control over how others see one; it leaves one open to coercion. (19)

Dan Tracy and Jim Leusner of the *Orlando Sentinel* found several examples of secrecy in their investigation after the *Challenger* accident. Both examples, as we shall see, are the result of fear. One shuttle technician said

> he couldn't talk about the Challenger or why it blew up in the skies over Kennedy Space Center.
>
> His bosses had told him the subject was off-limits to reporters and other outsiders. He did not want to lose his job.
>
> A NASA engineer, standing at the end of his driveway in the dark of night, said he wanted to talk, but couldn't. He feared not only for his job, but maybe even for his life. (A4)

As this article continues, we shall see what can happen to those employees at Thiokol and Marshall who do not keep secrets.

The Thiokol senior managers also had many reasons to deny that they were pressured. As we shall see in later sections, if one of the Thiokol senior managers who reversed the decisions of his engineers were to admit to being pressured, then he would risk alienating NASA, thus jeopardizing Thiokol's chances to win billion-dollar contracts.



Therefore, Thiokol senior managers denied being pressured. For example, when Presidential Commission chairman William Rogers asked Joe Kilminster if the Marshall managers "were trying to get you to change your mind," Kilminster replied, "I did not feel a significant amount of pressure in that regard" (United States, *Report* 4: 819). Similarly, when Jerald Mason was asked if Hardy's or Mulloy's comments had affected his thinking, he said, "It didn't make that much difference" (1: 95).

No Marshall engineer spoke out that night. Later, it was discovered that Ben Powers had opposed the launch. As we have seen, when Powers was asked why he did not press Marshall management, he fell back on the limits of his organizational role: "I should have taken over the meeting and all that. But, you know, really I'm not of that grade structure or anything." When people are reluctant to go beyond the letter of their job descriptions, it suggests that they are afraid of something. Deutsch and Krauss have said, "The more rigorously roles are defined, the more stringently are their prescriptions enforced, and, the more difficult it is for a person to resolve the conflict by deviating from them" (178). As we shall see in subsequent sections, the job prescriptions of Thiokol and Marshall employees were stringently enforced by Marshall managers.

Thiokol engineers and lower-level engineering managers at the teleconference on January 27, 1986, admitted that they felt pressure. Roger Boisjoly said, "I felt personally that management was under a lot of pressure to launch and that they made a very tough decision, but I didn't agree with it" (United States, *Report* 4: 793). When William Rogers asked Allan McDonald if he felt pressure, McDonald replied, "Yes, definitely. There was no doubt in my mind I felt some pressure" (4: 728). Thiokol special projects manager Brian Russell told the Presidential Commission, "I felt some pressure with some of the comments." Russell continued later, "I was wondering if I would have the courage, I remember that distinctly, to stand up and say no" (4: 821-22).

The conflicting testimony about the pressure from the Thiokol managers and engineers could be a matter of different temperaments, but I also think it can be explained by analyzing their organizational roles. After discussing the data with his engineers, Thiokol manager Jerald Mason turned to Bob Lund, and, in the words of Roger Boisjoly, "asked him to take off his engineering hat and put on his management hat" (United States, *Report* 1: 93). As Joseph Raelin says, "Management

and professionals are different" (3). Raelin explains that managers value hierarchies, respect for authority, corporate efficiency, team playing, and their careers. But professionals, such as engineers and lower-level engineering managers who do many engineering tasks themselves, value participation, the defiance of authority, social justice, individual initiative, and the quality of life (143). Thus, according to Raelin, different organizational roles influence the outlook of managers and professionals. Had the Thiokol managers not bowed to the wills of the Marshall managers, they would have shown disrespect for the authority of NASA and for team playing, and they may have endangered their corporation's future chances of winning government contracts.

Social pressure, of course, is everywhere in organizational culture and in human life. As many other writers have shown, people in organizations usually say what their bosses want them to say. One of Robert Jackall's informants explained the situation:

> You know that old saying: "Success has many parents; failure is an orphan"? Well, that describes decision making. A lot of people don't want to make a commitment, at least publicly. This is a widespread problem. They can't make judgments. They stand around and wait for everybody else's reaction. . . . The point is that in making decisions, people look *up* and look *around*. They rely on others, not because of inexperience, but because of fear of failure. They look up and look to others before they take any plunges. (77)

When people in such situations look up and around, they determine how the powerful people want them to react, and then they usually cooperate by telling those people what they want to hear. Engineers and engineering managers are no different. Edwin T. Layton, Jr. cites a number of engineers who believe that their communication is heavily influenced by their bosses and the values of their organizations. One of his sources, Arthur E. Morgan, the first director of the Tennessee Valley Authority, said that "the engineer tends to reflect, somewhat uncritically, the social attitude of his employer." Morgan also said that the engineer employed in a bureaucracy "tends to be not a free agent, but a technical implement of other men's purposes" (qtd. in Layton 13-14).

Exerting pressure on subordinates is a time-honored political maneuver. Politics, of course, is the attempt to influence people to gain such resources as time, money, or power. Porter, Allen, and Angle have summarized the methods of political influence, and one of the most important is "negative sanctions," which include coercion, physical punishments, threats, and so on (127). In another synoptic article, Frost has analyzed political influence in terms of games. Several of the most important intraorganizational games he mentions are scapegoating, defaming, isolating, and terminating (529). Frost has described organizational politics in terms of game playing, and he has divided the games into two categories: surface and deep structure. He says that



> the primary deep structure game currently recognizable appears to be a systematic distortion of communication so as to maintain and enhance power relations that favor one social reality over other possible alternates, that favor some interest groups at the expense of others. (532)

One of the most important facets of the "systematic distortion of communication" is not to betray that organizational politics is largely a game of constructing reality. As Molotch and Boden say, one of the key power struggles is "the struggle over the linguistic premises upon which the legitimacy of accounts will be judged." But such a power struggle "is also the least visible (and hence most unaccountable) form of power, precisely because the manipulations upon which it rests are the fundamentally *tacit* procedures that cannot ordinarily be discussed in social discourse" (273). People who reveal the tacit procedures are suspect because they expose themselves to other members of the organization as being overt political manipulators—and thus as being excessively self-interested—and as being indiscreet—and thus as being a threat to anyone who confides in them. People who reveal tacit procedures, as Bok has said, also open themselves to coercion.

Discussing political influence as it applies to a specific case is especially difficult because such activity is disguised for selfish reasons. According to Peter Frost, political behavior is "intentional, self-interested, and nonconsensual" (503). Institutions have strong prohibitions against individuals who are overtly self-interested, because institutions place their own interests ahead of those of individual members. Other institutional members, of course, might feel that an ambitious co-worker is a threat to their own ambition. Thus politicians conceal their influence attempts (Porter, Allen, and Angle 116). Entire institutions are also self-interested and can engage in behavior that cuts them off from such higher values as honesty, fair play, and respect for life. When a reformer steps forward to align the institution with higher values, the entire institution may move against the reformer. In such situations, "It frequently seems that practically every-

one except the reformer has a personal stake in preserving the complicated fantasy of the organization" (O'Day 383). The "complicated fantasy" extends to people refusing to admit that political influence even takes place. As Porter, Allen, and Angle say,

> *Political* aspects of behavior in organizations . . . are something that organizations (qua organizations) tend to deny exists in their *own* operations, or at least tend to deny that it affects any crucial decision making; likewise, individuals tend to deny that they themselves engage in it. (134)

Although people conceal or deny their attempts at political influence, politics is still a constant in organizational life, and new employees are wise to figure out the organization's political norms as soon—and as quietly—as possible. But because so many political norms are, as Porter, Allen, and Angle say, "apt to be sent in disguised format and against a noisy background" (113), new members of an organization must figure out what these political norms are "through inference" (116). The main way that people in organizations make their inferences is, as Jackall's informant explained, to "look *up* and *around*." They see what their superiors do and how the actions of their superiors affect others in the organization. This article will show what people at Thiokol and Marshall saw when they looked up and around. By looking up and around, ourselves, we shall see how Marshall managers, among others, intimidated Thiokol managers to overrule their engineers and how Marshall managers intimidated their own engineers.

## A DEFINITION OF INTIMIDATION

Intimidation occurs when actor A uses direct or indirect threats to pressure actor B to perform some objectionable act, that is, some act that actor B would not otherwise do because it is unethical, unlawful, or somehow inappropriate. This formulation is based on Robert A. Dahl's famous definition of power: "A has power over B to the extent that he can get B to do something that B would not otherwise do" (202-03). To have intimidation, one or more of the following four conditions must exist:

1. *Fear of the power of retaliation.* The sender of the message must have some power over the receiver, and they must both know it. The receiver must also believe that some harm will be done to him or her. The belief might come from previous harm done by the sender to the receiver or from the receiver's witnessing or hearing stories about how the sender or sender's allies have harmed others. The harm might be physical, psychological, financial, or administrative, although in bureaucratic organizations it is almost always the latter three.
2. *The perceived inability to get justice or redress, either in the short or long term.* That is, the sender and receiver of the intimidating message must think that the sender will get away with influencing the receiver to do some objectionable act because no one will do anything about it, at least for a short while, or because the sender will be able to muddy the trail of the interaction so as to hide his or her tracks.
3. *The feeling of pressure not to pass along bad news.* This pressure is the complex burden of distress felt from all the circumstances of the moment, and it is the distress felt from the memories of past experiences with the sender of the message or the sender's political allies. Some of those circumstances include the two conditions mentioned earlier, but the pressure can come from other circumstances special to the occasion or organization.
4. *Some objectionable act, an act that is unsafe, unlawful, unethical, against professional or organizational procedures, or in some way inappropriate.* The key objectionable act on the night of January 27, 1986, was reversing the decision of the Thiokol engineers not to launch.



Subsequent sections will elaborate how each of these conditions applied to the decisions about the O-rings.

### The Power to Retaliate

The first prerequisite for intimidation is that the managers suggesting or demanding an objectionable act have the power to retaliate against the person doing or not doing the act. The managers at Marshall Space Flight Center had this power and used it. Because Marshall supervised the development of the solid rocket boosters, its managers had the power of retaliation over its own employees and over the employees of its contractors. As we shall see, Marshall had a well-known policy of sanctioning ethical reformers in its own organization. Thiokol was also vulnerable to retaliation from Marshall, Congress, and its competitors because its contract for its solid rocket boosters was coming up for renewal soon after the launch, and it was preparing to bid on several other government rocket contracts. A launch delay because of questionable O-rings would make Thiokol look bad at the negotiating table.

The case of William C. (Bill) Bush, formerly an engineer at Marshall, will illustrate how senior Marshall managers applied their power to

their own employees. (Other examples will be discussed in later sections.) In June 1974 Bush was given another job in the auxiliary equipment branch of the Science and Engineering Directorate at Marshall. Bush believed that the reassignment resulted in a reduction in rank, and he filed an appeal with the review board of the United States Civil Service Commission. The Civil Service Commission review board ruled in February 1975 that Bush had been wrongly reduced in rank (Casebolt 4). Marshall management then assigned Bush a supervisory position that had little real work, few responsibilities, and no one to supervise. Bush wrote to Marshall management asking that his position be abolished and that he be given a meaningful job. Bush also appealed to the Civil Service Commission to audit his job to see if it could be abolished (Casebolt 1). David Caldwell, the regional Civil Service Commission director in Atlanta, wrote Bush that the commission "has confirmed several of the allegations made in your appeal" ("CSC Audit").[2] Bush's actions to get his job abolished were published in newspapers around the country, including *The National Enquirer*, and he appeared on local Huntsville television to discuss the charges.

While these actions were going on early in 1975, Bush read several Marshall memos containing statements of age discrimination. The statements violated the Age Discrimination in Employment Act of 1967, which was extended to apply to federal employees in 1974. In a letter dated April 5, 1975, to Joanne Monk, the age discrimination coordinator for the U.S. Civil Service Commission, Bush said that he planned a lawsuit against Marshall. Marshall management decided to rescind these memos after they had been made public (Casebolt 4). Although Bush never sued Marshall for age discrimination, he did publicly urge others to file appeals with the Civil Service Commission in the "Letters" section of *The Federal Times* on January 1, 1975 ("Fight"). Walter K. Polstorff and Helmut G. Krause, both Marshall scientists, sued NASA for age discrimination; they won their cases in 1978 ("Scientists").

On August 1, 1975, J. E. Kingsbury, director of Science and Engineering at Marshall, notified Bush in a 14-page, single-spaced letter that he was going to be fired. Bush hired a lawyer and tried to save his job (personal interview). A number of legislators, including Senators Edward Kennedy of Massachusetts, William Proxmire of Wisconsin, Henry (Scoop) Jackson of Washington, and John Sparkman and James B. Allen of Alabama were concerned about the matter ("Con-



gress"). The management at Marshall was unable to fire Bush and decided to demote him from his civil service ranking of GS-14 to GS-12, which cut his pay by $10,000 per year. Again, Bush appealed through the civil service system. Almost three years later, he won. He was ordered reinstated with back pay. But he still had nothing to do, and he was assigned a tiny office (personal interview).

To keep his job and obtain justice, Bush publicized his plight in various ways to gain support from members of Congress and from the press. As a result of Bush's efforts, which were documented in newspapers, magazines, and television programs, virtually everyone at Marshall Space Flight Center knew about him and what had happened to him. Ben Powers certainly knew of Bush, and he told me so at length in a phone interview. The publicity Bush's case generated, and the publicity generated by his fate—the attempted firing, the demotion, the tiny office, his legal expenses, the isolation, his lack of meaningful work—was not lost on other Marshall employees. Jerry Cox, a Marshall engineer, told Philip Boffey that "there is definitely fear of being relegated to do nothing, or of being laid off the next time there is a reduction in force. That fear permits management to do almost anything it wants to do" (Boffey A1).[3] Cox's statement echoed one of the sanctions that Marshall had taken against Bush.

Government agencies and their contractors have great power over their employees, and they have many ways to discredit or sanction anyone who speaks out against them. Bill Bush listed these sanctions in a statement to the United States Senate Subcommittee on Federal Services, Post Office, and Civil Service. The sanctions include

> transfers/reassignments causing hardships on the employee, perpetual temporary duty far away from the employee's residence, orders to take fitness-for-duty examinations for punitive purposes only, isolation from assigned duties, assignment to duties beyond the capabilities of the employee, reprisals against relatives of the employee, reprimands, overly frequent reassignments, revocation of security clearances, blacklisting from deserved promotions, assignment to undesirable office facilities. . . . ("Statement" 490)

Once employees are sanctioned or fired, it is up to them to prove their innocence. Such a process can be very time-consuming, expensive, and emotionally exhausting. The senior managers in the federal government and in billion-dollar defense contractors have many resources, including money, powerful political connections, a mastery of the rules of the system, ready access to legal advice, and staffs of

employees to do their bidding. Sanctioned employees, especially those who are unemployed, have few resources. While they are trying to clear their names, their careers are stalled, but the managers who sanctioned them can continue to work in their career paths.

While the managers at Marshall had power over their own employees, they also had a strong indirect influence on the employees at Thiokol. Thiokol was Marshall's subcontractor; therefore, Marshall was the boss. As Ben Powers said in an unpublished interview with the Presidential Commission, "Our managers can direct that contractor [i.e., Thiokol] to do anything they want them to do" (40). To extend its contract with NASA and keep NASA's business, Thiokol had to cultivate the goodwill of Marshall management (which supervised Thiokol's contract), Congress, and NASA senior management in Washington, D.C. The length to which Thiokol would go to keep the goodwill of NASA management was shown in the aftermath of the *Challenger* disaster. When Roger Boisjoly and Allan McDonald of Thiokol criticized NASA in their testimony to the Presidential Commission, Thiokol management relieved them of their responsibilities, in effect giving them a suspension with pay. Members of the Presidential Commission reacted strongly, and Boisjoly and McDonald were reinstated. Thiokol's president, Charles S. Locke, explained the situation later in his testimony to the United States House of Representatives Committee on Science and Technology:

> In the course of these [personnel] changes, we came to believe that Al McDonald, who had spoken candidly, but harshly, about NASA in the investigation, should operate in an environment where he could continue to do important work, but in which he would be less likely to interact directly with the agency.
>
> We could not afford the possibility of friction, which would be counterproductive to the important work ahead. (United States, *Hearings* 1: 327-28)

There is some evidence in the testimony given to the Presidential Commission that McDonald spoke "harshly." He said that a statement by Lawrence Mulloy about the mean bulk temperature of the propellant in the solid rocket booster was "asinine" (United States, *Report* 1: 95). McDonald also testified that he told Mulloy

> if we're wrong and something goes wrong on this flight, I wouldn't want to have to be the person to stand up in front of [a] board of inquiry and say that I went ahead and told them to go ahead and fly this thing outside what the motor was qualified to. (1: 95)



Marshall, as we shall see in a later section, did not seem to like negative criticism, and Thiokol apparently wanted to accommodate them. As Locke said further, Thiokol "could not afford the possibility of friction," and he refers to the "important work ahead."

The "important work ahead" probably referred to the job of redesigning the field joints on the solid rocket boosters (SRBs), or to the second phase of Thiokol's contract for SRBs, which was coming up for renewal soon after the launch. The number of boosters in the first phase was to be used up by the end of 1986, and Thiokol, as Malcolm McConnell said,

> was actively negotiating for the second-phase contract that would cover the next sixty sets of boosters, a procurement award worth a billion dollars. However, other aerospace companies had been lobbying Congress for at least two years to force NASA to break Morton Thiokol's monopoly on producing the SRB's. In the fall of 1985 Thiokol's management was acutely aware of this lobbying effort, which Congressional staff members called a "full-court press," by Thiokol's competitors. (180-81)

McDonald told the Presidential Commission that he had been to Marshall the week before the launch "on some negotiations for a subsequent contract" (United States, *Report* 4: 714). Although Thiokol people worked with Marshall during the fall of 1985 and into the early months of 1986, Thiokol's managers knew that the second phase of their contract with NASA was in some danger. As McConnell explained,

> Eighty House members had lobbied NASA to consider accepting the bids of other contractors. Although Thiokol was assured of a short-term extension of its contract, NASA had stunned the company the day after Christmas by proposing to develop procedures for a second source for later procurement. The previous three weeks had been a period of intense negotiations between Thiokol and NASA over the terms and duration of the extension. (190)

Thiokol's managers had planned another meeting to negotiate its contract with NASA on Tuesday, January 28, 1986, the day that the *Challenger* blew up (McConnell 190).

McConnell believes that these negotiations must have weighed heavily on the minds of the senior managers at Thiokol who overruled the engineers. NASA and Congress had the power over Thiokol's government contracts. If Thiokol did not launch on January 28 and named the O-rings as the reason, it would weaken its negotiating position. It would also give its competitors and some members of

Congress reason to take away the second phase of the contract that was up for negotiation. Thiokol manager Brian Russell's unpublished interview with the Presidential Commission corroborates this belief. Russell told a Presidential Commission investigator that when Jerald Mason, the senior vice president of Wasatch Operations at Thiokol, and Calvin Wiggins, the vice president and general manager of Thiokol's Space Division, heard about the late meeting on January 27, 1986, and when they realized "the magnitude of the request [i.e., not to launch] that we were about to make" (15), they joined the meeting. Later in his unpublished interview, Russell said:

> I realized the ramifications of delaying the launch. I realized that by doing that we would bring scrutiny to our own [O-ring] design.
>
> The question had come: Well, why? Why are you delaying this? And people will tend to hone in and see, well, gee, you've got an O-ring problem, don't you? And that wasn't public, of course. (28)

Making the problem public would only increase the pressure on Thiokol management.

### Lack of Justice

The second condition for intimidation is the perceived lack of justice; that is, the sender and receiver of the message must believe that the sender will get away with the objectionable act. Both Marshall employees and Thiokol managers had reason to worry about justice.

It was difficult for federal employees to get justice at Marshall, or at any other federal agency, because of the doctrine of sovereign immunity. Under sovereign immunity, the federal government and its officials cannot be sued in many cases without its own consent. For example, government officials have immunity from lawsuits if they err "in the exercise of 'judgment and discretion,' " and supervisors cannot be sued for torts by their subordinates (Schuck 38). The Federal Tort Claims Act (FTCA) of 1946 does provide "a damage remedy for personal injury, death, or property damage caused by the 'negligent or wrongful act or omission' of any federal employee acting within the scope of his or her employment." But in general, the FTCA is full of holes that favor the United States (Schuck 41). People suing the federal government for damages rarely succeed, as one family of an astronaut killed in the *Challenger* accident has found out:

> Jane Smith, wife of one of the seven astronauts killed when the shuttle *Challenger* exploded in 1986, lost an appeal to the Supreme Court in an effort to revive a lawsuit. The court left intact a ruling that shields the federal government and NASA employees from being sued. ("Jane Smith," A1)[4]



Bill Bush also found that he was unable to receive compensation for the repeated sanctions taken against him by Marshall management. After he was sanctioned for exercising his First Amendment rights to complain about bad conditions at Marshall, he filed a $1 million-dollar lawsuit in the United States Fifth Circuit Court against William Lucas, the director of Marshall Space Flight Center, for infringing his free speech. Bush lost his case. Bush then appealed to the Supreme Court, but he lost in a 9-0 decision. The Supreme Court ruled in *Bush v. Lucas* "that the civil service system provides meaningful, if not equal, remedies for federal workers whose rights are violated by their bosses, thus closing the door to personnel-related constitutional lawsuits by employees" (Sinzinger). Sovereign immunity and cases like *Bush v. Lucas* place all federal employees at a great disadvantage. They can complain outside the federal system about any mismanagement, but if they do, they can be sanctioned by federal supervisors in the ways described by Bill Bush in the previous section. In a 5-4 decision handed down on April 20, 1983, the Supreme Court ruled "that protected free speech for public employees does not include complaints about their workplaces or superiors" (Sinzinger). If federal employees are sanctioned, there is little they can do about it, so long as the federal supervisors do not break any rules.

Even when federal supervisors do break the rules, they can still retaliate against an employee almost at will. Bush, for example, was able to show on many occasions that his supervisors did break the rules, and he was usually supported by the federal civil service appeals process. But every time he won, his supervisors at Marshall found another way to sanction him. Although civil servants can appeal to the Merit Systems Protection Board, those appeals, until very recently (early 1989), have been perceived as being useless or outright detrimental to one's case. As Hugh Heclo says,

> It is relatively easy for political executives to get rid of an ethical official who is seriously committed to the idea of a civil service career and almost impossible to move a deficient bureaucrat who allies himself with outside political forces and uses the technicalities of the rank-in-job personnel system. (141)

To some extent, Marshall managers were able to do what they wanted without putting themselves at risk. Because of sovereign immunity

and the limits of the civil service system, federal engineering employees at Marshall were relatively powerless to rectify problems that they saw with the *Challenger*.

As for Thiokol, the way it originally won its contract for the SRBs was highly political, and because the political winds had changed by January of 1986, Thiokol might not have won the new contract that was then under negotiation. Government procurement is often an intensely political process in which the corporation with the best technical solution to a problem is not guaranteed the contract. Powerful friends in high places can be more important than an excellent engineering design. Thiokol management knew how this process worked. It had an example right under its nose—its own contract to build the SRBs. Malcolm McConnell and Anson Shupe explain how Thiokol got its contract for the SRBs in their books, which I refer to frequently in the remainder of this section.

Thiokol owed its contract for the SRBs to Dr. James Fletcher. Fletcher, who was president of the University of Utah from 1964 until 1971, became the head of NASA in 1971 (he left in 1977). He was well acquainted with Utah; he had lived there for a long time, and his wife was from Brigham City, where Thiokol is based (McConnell 51). Fletcher was a member of the board of directors of Pro-Utah, Inc., which "aggressively courted corporations and contracts for Utah industries" (Shupe 148). When a reporter asked Fletcher about his connections to Utah after the *Challenger* accident, Fletcher said, "I had no commitments to Utah" (McConnell 52).

In July 1973, NASA sent out requests for proposal for the SRBs to four corporations: Thiokol, United Technologies, Aerojet Solid Propulsion Company, and Lockheed Propulsion Company. The last three companies were based in California. The companies made their proposals to the Source Evaluation Board, which judged the proposals numerically based on complex criteria relating to management, economics, and engineering excellence. Aerojet had the best evaluation for engineering, because its SRB proposal was for a one-piece booster casing that would prohibit failures at the joints—the material cause of the *Challenger* accident. Despite its better engineering design, Aerojet came out last of the four. Lockheed was first with 714 points, Thiokol tied for second with United Technologies at 710 points, and Aerojet had 655 points. Fletcher said that the top three were effectively in a tie, and he selected Thiokol because of its low cost and high scores in management.



Lockheed protested formally after the announcement of the contract award. The Government Accounting Office (GAO) evaluated the protest, compared the proposals of Thiokol with Lockheed, and found that "the two corporations' projected costs fell within a fairly close range" (Shupe 150). The GAO publicly asked Dr. Fletcher to reconsider his decision, although it acknowledged that the final decision was his. Fletcher awarded the contract to Thiokol, and he even praised the Thiokol case joints.

This dispute over the award of the contract to Thiokol was published in the *Wall Street Journal* ("NASA Recheck"; "NASA Said") and the *Washington Post* ("GSA Questions"), and it was certainly known to Thiokol's senior management, which had worked on the contract. Thus Thiokol's managers knew that the original award of the contract was disputed and that it was very political. They knew that Fletcher had been gone for years and that pressure was being applied by many members of Congress and by two of Thiokol's former competitors. Thus in January of 1986, Thiokol management had to be worried that if they postponed a launch because of trouble with O-rings, they might lose their contract extension, *and*—given the politics of government procurement—they would not be able to do much about it. Justice had not prevailed in the original award of the contract to Thiokol; there was no reason to expect justice now.

## Controlling Bad News

The third condition for intimidation is that a person feels pressure not to pass along bad news. In the 10 years or so prior to the *Challenger* accident, managers at Marshall made it clear to their employees that they did not like bad news. If these managers heard bad news, they did several things:

1. They subjected messengers to harsh interrogations.
2. They did not share bad news with other branches of NASA.
3. They minimized bad news, sometimes reducing it to a one-line item in a report or even eliminating it entirely.

Any employee looking up and around before making a decision could not help but know Marshall's attitude toward bad news.

*Pressuring the Bearer of Bad News*

We noted earlier how George Hardy questioned the Thiokol engineers the night before the *Challenger* accident. As Ben Powers said, "He was really wringing them out." Powers indicated that if Hardy stopped the launch, he might have to explain his decision to his superior, William Lucas, the director of Marshall Space Flight Center. Lucas was well known around Marshall for disliking bad news. Several years before the *Challenger* accident, Lucas was riding in a Marshall taxicab on the center grounds and saw workers painting a building brown. Lucas stopped the cab and went over, as Scherberger explained, "to investigate":

> The next day, the same cab driver was escorting a visitor from NASA headquarters when they passed the same building. When the visitor admired the color, the driver said, "You'd better not tell Mr. Lucas you like it." When Lucas found out what the driver had said, he was furious and demanded that he be punished. A written reprimand was put in his personnel file. (A9)

In this passage, the bad news is only the cab driver's awareness that Lucas did not like the color of the building. But Lucas reacted to the driver's remarks with a request that the driver be punished. Many Marshall employees and other sources have confirmed Lucas's dislike of bad news. Ernest Nathan, who has been a Marshall engineer since 1962, said that Lucas

> does not want people to bring up problems. So engineers have become conditioned, if they have to make a presentation, to do some cover-up. If there is a potential problem they just glance over it or smooth over it. They don't present the details because Lucas would jump down their throat. (Scherberger A9)

Roger Boisjoly told me in a telephone interview that Lucas verbally "beat up his own people" in meetings. Boisjoly emphasized his point by saying "I witnessed that" several times. Robert W. Smith, author of a book on the Hubble space telescope, said that Lucas's management style "throttled public criticism" (302). Some meetings about the space telescope were held at Marshall. One of the people involved in those meetings in late 1983 was Samuel W. Keller, who told Smith the following:

> A series of reports are made by the various elements of the project, and when you would listen to the reports everything seemed fine, you'd go out in the hallway and talk to the presenter, and he would deny much of what he'd just said. . . . I think there was a very conscious effort at all levels of the project not to rock the boat in a public meeting. I understand that all the presentations that were made were sent to the project for review prior to these sessions. Some of these people have shown me copies of presentations submitted for clearance which came back marked up, with comments like, "This item is too controversial," or "don't bring this up in front of Headquarters." The reports were put together in such a fashion that they were not controversial. (302)



The result of this lack of candor about problems, says Smith, is that "the impression given to many observers was of an almost endless round of good news, and most speakers basically seemed to be presenting what they thought Lucas wanted to hear" (303). To people like Samuel Keller, "there was an aura of schizophrenia to the [space telescope] program" (303).

The pressure that Marshall managers used against bearers of bad news comes out most clearly in an incident that took place while the Presidential Commission was doing its investigation. Allan McDonald told the Presidential Commission that after he had testified to them about his complaints about the O-rings, he had a run-in with Lawrence Mulloy. McDonald said that Mulloy

> came into my office and slammed the door, and as far as I was concerned, was very intimidating to me. He was obviously very disturbed and wanted to know what my motivation was—and I won't use his exact words—for doing what I was doing, and I asked him what's his problem? Do you mean what my testimony was? And he said no. As I understand it, you're giving information to the Commission without going through your own management, without going through NASA, and what's your motivation for doing that? (United States, *Report* 5: 1597)

McDonald was in a double bind. If he went through NASA channels, he might, at the least, have to suffer a very unpleasant interrogation. And, as we shall find out later in this section, his information may not even be passed on much higher in the Marshall bureaucracy. If he went around NASA channels, he would be intimidated by people like Mulloy. Mulloy's version of the situation was different. He said he went into McDonald's office, and "I then closed the door. I didn't realize I slammed it. I was not upset" (Reidy). I asked Jerry Cox, a Marshall employee, if he had ever seen any slamming of doors and banging things around in his time at Marshall. He explained that he did not attend technical meetings, but he did attend meetings about personnel matters. Then Cox said, "There was some of that." Cox also

told Boffey, "There is widespread fear of management among the employees" at Marshall (A1).

*Not Sharing Bad News with Other NASA Installations*

Another strategy for controlling bad news was Marshall's policy of not sharing information with other branches of NASA. The Presidential Commission referred to this practice in their "Findings" section of chapter 5. The commission said that it

> is troubled by what appears to be a propensity of management at Marshall to contain potentially serious problems and to attempt to resolve them internally rather than communicate them forward. This tendency is altogether at odds with the need for Marshall to function as part of a system working toward successful flight missions, interfacing and communicating with the other parts of the system that work to the same end. (United States, *Report* 1: 104)

Members of the Presidential Commission and senior NASA managers told reporters from *The Orlando Sentinel* that Marshall was stingy with information. As Tim Smart said, "Key NASA officials have said they had to fight tooth and nail sometimes to get information out of Marshall Space Flight Center" ("Roots" A14). NASA chief engineer Milton Silveira said that the problem was "serious enough to cause the accident." Silveira went on to say that " 'the guys at Huntsville blind-sided' top shuttle officials by not reporting engineers' concerns the night before the Challenger's launch that the boosters could fail in the cold" (Fisher and Scherberger A14).

Even though Arnold Aldrich ran the shuttle program from the Johnson Space Flight Center in Houston, William Lucas would not always give Aldrich the information that he wanted. Lucas made the point in his testimony before the Presidential Commission that "I have never on any occasion reported to Mr. Aldrich" (United States, *Report* 5: 1039). Aldrich told the Presidential Commission that technical reviews by Marshall and the budget for additional SRB casings were not routed through his office. He termed this situation a "breakdown in communication," and said if he had been responsible for the SRB budget, "it would have been clear that something was going on here that I ought to know about" (1: 102-03). As a result, NASA officials sometimes had "to go through unofficial channels to find out what was happening in the agency they were supposed to be leading" (Fisher and Scherberger A14). Aldrich could not get rid of Lucas, who had a lot of power and seniority. Also, because of budget cuts, there were not enough budget analysts and engineers at Washington headquarters to supervise the field centers at Marshall and elsewhere (Fisher and Scherberger A14).



The upshot of this lack of desire to pass information around caused one of the most important failures of communication that the Presidential Commission studied. After the teleconference was finished the night before the accident, Stanley Reinartz, director of the shuttle projects office at Marshall, called William Lucas to tell him about it. But Reinartz did not tell Arnold Aldrich or Jesse Moore (the associate administrator of space flight at NASA and the director of the Johnson Space Center in Houston) about it, and Moore made the final decision to launch. Lucas also did not share the information with Aldrich or Moore. As General Donald Kutyna of the Presidential Commission said, "if you want to report a fire you don't go to the mayor" (United States, *Report* 5: 918). You call the fire department. But no one called the right people the night before the *Challenger* accident.

*Minimizing Bad News*

A final problem was minimizing bad news. Winsor has discussed the problems that NASA and Thiokol engineers had about sending on bad news to superiors. The data that I have found make her case even more compelling. Some Marshall managers focused on data that emphasized the positive so that launches could be continued. Or they minimized bad news more and more as they sent it higher in Marshall's administrative hierarchy. By the time the bad news reached the top, there was very little of it, or it was gone entirely.

Perhaps the most striking evidence of how Marshall managers minimized bad news is the way they handled the concerns of engineers about the design of the O-rings. Engineers at Marshall and Thiokol repeatedly questioned the safety of the O-rings and the field joints in memos and reports. The earliest of these memos was signed more than eight years before the *Challenger* accident, on January 9, 1978, by John Q. Miller, head of the solid rocket motor group at Marshall. Miller objected to the proposed thickness of the shims (wedge-shaped pieces of metal) that were to be installed in the joints to prevent leakage of white-hot gas at the seal. Miller wrote, "We strongly object to this proposal because it creates unacceptable risks which can be and should be avoided." Miller signed another memo

dated January 19, 1979, that said that Thiokol's position about the joints was "completely unacceptable" (Smart, "History"). Miller was asked about these memos in an unpublished interview with one of the Presidential Commission staff members, Raymond Molesworth. Miller had written one of the memos to his boss, Glenn Eudy, who was the solid rocket motor chief engineer for science and engineering. When asked about the answer he got back from Eudy, Miller said, "Well, I didn't ever get any specific response as to why they [Miller's concerns about the O-rings] were not being implemented. You know, I can't push past the chief engineer" ("Interview," 27 Mar. 1986, 28). Later in the same interview, Miller was asked how upper management at Marshall responded to his requests that the joint containing the O-ring be redesigned. Miller replied:

> You know, when you present something, a concern to someone, and nothing is perhaps immediately done, you don't—in the position I was in, you don't push the point and try to back them in a corner: When are you going to do something and why aren't you going to do something? (35)

A subordinate engineer or employee at Marshall did not try to overstep the limits of his place in the hierarchy.

Another memo, dated February 6, 1979, reported a visit to the Parker Seal Company in Lebanon, Tennessee. According to William Ray, an employee at Marshall, officials of the Parker Seal Company, which manufactured the rubber O-rings, expressed "surprise that the seal had worked so well in the present application." The Parker Seal officials said "their first thought was that the O-ring was being asked to perform beyond its intended design and that a different type of seal should be considered" (Smart, "History"). That memo too was not acted on by Marshall management.

At least four other memos in 1984 and 1985 warned, among other things, that the "failure of putty used to protect the O-rings from hot gas 'can lead to burning both O-rings and subsequent catastrophic failure' " (Smart, "History"). One report exactly predicted the ultimate cause of the disaster:

> On September 3, 1980, an aerospace industry advisory group told NASA of its concern "that damage could occur to the O-ring[s] that are used in the joint for pressure sealing" the individual segments of the shuttle's booster rockets. "Damage to the O-rings could allow a hot gas leak which could grow in magnitude and could impinge on the ET [external fuel tank] during flight." (Smart, "History")



The concerns reflected in these memos and reports were passed upward in the management structure at Marshall, but as they went higher up, they became minimized until, finally, they had little effect on the people with the real power at Marshall—the senior managers.

The Presidential Commission members and staff were especially concerned with this problem at their hearings. Alton Keel, the Presidential Commission staff director, said that many reviews and memos had been " 'winnowed down to one bullet entry' on a single memo" (Smart, "Rogers" A19). William Rogers said:

> If you read the documents, it seems to me everything was almost covered up, ever so slightly noted, and it seems to be such a serious problem, and the papers reflect that a lot of you [i.e., Marshall and Thiokol people] thought it was serious, and yet it doesn't seem that serious when you read the documentation. (Smart, "Rogers" A1, A19)

On the night before the launch, Allan McDonald, at the Kennedy Space Center in Florida, also encountered the same desire to minimize bad news in NASA management's reactions to his 13-page presentation about his analysis of the O-ring problems. In an unpublished interview to the Presidential Commission, he said:

> Eleven of those pages had absolutely nothing but bad news. There is one page that has what I call neutral, but it may be considered more bad. . . . There is one page that has one positive piece of information on it. That was a subscale O-ring [test] that we ran one at 30 [degrees] and we ran one at ambient [temperature] or something, or 70 [degrees], and they both performed fine. That is the only positive piece of information out of 13 pages. (57)

Ben Powers thought the subscale O-ring test mentioned above was worthless. In Powers's words, "It's a sub-scale test, static, and to me that's just—wad it up and throw it in the trash can, you know" ("Interview" 24). Subscale, static tests do not give data that are as realistic as scale model tests. However, despite the fact that the large majority of the information in McDonald's presentation did not favor a launch, the Marshall managers who heard it regarded his presentation as being in favor of launching. As McDonald explained, "So, my felling is that people were really grasping for straws for any kind of positive information to support a launch . . ." (Interview," 57). Passing along bad news the night before the launch of the *Challenger*, or any other night, went against an unwritten policy of the Marshall Space Flight Center: "The policy, according to some Marshall employees,

translates into never slow down the program and never rock the boat" (Glisch A15).

## The Objectionable Act

A sender of an intimidating message wants the receiver of the message to do some act that would normally be objectionable. The objectionable act may be an error of omission, such as not performing a safety check, or an error of commission, such as falsifying records. The Thiokol managers who received the intimidating message on the night of January 27, 1986, acted objectionably when they overruled their engineers on an issue of technical judgment and recommended the launch.

When the stakes are as high as life and death and the issue is technical, it is not good engineering practice for managers to override the judgment of the technical specialists. The technical specialists have a better sense of what will work or not. As Ben Powers explained in an unpublished interview with the Presidential Commission,

> Let's say that I say a piece of hardware is unacceptable. Now a manager would be a fool to overrule me on that. He'd be an idiot to overrule me, because if that hardware doesn't work, you know, it's just ridiculous to overrule an engineer like that. (68)

Managers—even technical managers promoted from line engineering positions—do not know the data as well as the technical specialists. John Q. Miller, an expert on field joints in the SRBs, had been promoted at Marshall from an engineering position into program management in April of 1985. Miller told a Presidential Commission employee in an unpublished interview about how he was no longer able to "appreciate" the technical knowledge about field joints now that he was in program management, even though at the time of the teleconference on January 27, 1986, he had been away from the field joints for less than a year. When the interviewer asked if "the Thiokol engineers did a good job of articulating their analysis of the data? Did they communicate well?" Miller responded as follows:

> Well, I guess they communicated. I didn't fully appreciate all the data that they went over because having not tracked it on a day by day or week by week basis, I would not be expected to fully interpret what they were perhaps trying to get across. ("Interview," 13 Mar., 15)



None of the other managers at Thiokol or NASA that night had tracked the field joint data "on a day by day or week by week basis," and none was an expert on field joints. Yet they felt competent to challenge and overrule the engineers' decision not to launch.

During their public hearings, Presidential Commission members also questioned Ben Powers on how persuasively Thiokol presented their data the night before the launch. Powers had worked at Marshall for 20 years, in the Solid Rocket Motor Branch for 14 of those 20 years. Powers had, as he put it, "fully supported the Thiokol engineering position and was in agreement with it" (United States, *Report* 5: 1064). When Chairman Rogers asked Powers if he had told Hardy about this, Powers said he had not, but Powers had reported it to John McCarty and Jim Smith, his immediate superiors in the management hierarchy at Marshall. McCarty and Smith said nothing to Hardy about Powers's opinion. Rogers asked if Powers had talked to other Marshall engineers afterward about their opinions, and Powers said he had and that the other Marshall engineers were concerned with the effects of the low temperature on the resilience of the O-ring. Those engineers, however, said nothing about their concern (1064-65). Powers told one of the Presidential Commission employees in an unpublished interview that the conflicting data presented the night before the launch came from subscale tests, tests that he thought were worthless. Powers said he thought the blowby, that is, the soot that had been pushed through the seal, was very bad. He added, "you know, I'm responsible for working this kind of thing down as an engineer and working it day-in and day-out, not just during investigations, you know, then it [the blowby] really hit me hard" (24).

After the *Challenger* accident, one aerospace engineer in Southern California wrote a letter to the *Los Angeles Times* in response to a cartoon by their Pulitzer prize-winning political cartoonist Paul Conrad:

> In Paul Conrad's cartoon (Feb. 27, 1986), "Autopsy of a Catastrophe," a drawing of the space shuttle *Challenger* is labeled with words like "MONEY" and "SCHEDULE" etc. Forty years experience as an engineer in the aerospace industry leads me to believe that Conrad has (uncharacteristically) defused the issue.
>
> He could have used one word, "arrogance." The arrogance that prompts higher-level decision makers to pretend that factors other than engineering judgment should influence flight safety decisions and, more important, the arrogance that rationalizes overruling the engineering judgment of engineers close to the problem by those whose expertise is naive and superficial by comparison.

> The flaw is not in the decision-making process; it is in the decision-making mentality. Consequently it would be of little value to move engineering decisions to a higher level, as has been contemplated by members of the presidential investigating commission. (qtd. in Martin and Schinzinger 84-85)

Brian Russell witnessed "the decision-making mentality" firsthand the night before the *Challenger* accident. In an unpublished interview, Russell told about the discussion between the Thiokol managers and engineers on the night of January 27, 1986:

> And so as we argued back and forth, it was apparent that we were not going to come to a unity of position. And Jerry Mason said something to the effect that we have ploughed this ground before. . . . So he said it was time to make a decision, and he said I am prepared to launch, or something like that. He was casting his ballot to launch as scheduled.
>
> He turned to Cal Wiggins and asked him whether he recommended to launch, and Cal said yes. And then he asked Joe Kilminster. And this is the time in my own mind that I wasn't sure if I was going to be asked. (27)

Joe Kilminster said yes, and then Mason turned to Bob Lund and asked his decision. But Lund did not answer immediately. In fact, Russell believed that Lund "was struggling in his own mind" (30) for about five minutes.

After Lund struggled with the question for a few minutes, Russell reported that

> Mr. Mason said, take off your engineering hat and put on your management hat.
>
> And there were some people that were upset at that comment, I guess. You know, that's a comment that tends to come up: Let's make a decision here. And all right, it would be somewhat of a pressure comment, but in my own mind he [Lund] is the Engineering Manager. . . .
>
> So that's when he made that decision [to launch]. I was dismayed at that. (31-32)

Later in the teleconference, after Thiokol's managers had decided to overrule the engineers, Russell wondered if the engineers at Marshall were hearing the concerns of the Thiokol engineers. Russell told the Presidential Commission interviewer that he thought to himself, "where are the Leon Rays and the Jerry Peoples and the Ben Powers and those people? Are they there? And if they're there, can they hear us, because we're the working level people and we had constant contact with them" (36). Leon Ray and Jerry Peoples were not at the meeting, and although Ben Powers was present, as a "working level" person, he would not exceed the limits of his grade structure and voice his objections to the senior manager present, George Hardy.



## CONCLUSION

When one or more of the conditions that I have been discussing are met—that is, when there is fear of retaliation, when there is little or no chance to get justice, when there is pressure not to pass along bad news, and when there is an objectionable act—then there is intimidation. If managers intimidate the technical experts who keep an organization in touch with reality, then sooner or later the organization will feel the effects of the intimidation. Marshall managers—intimidated themselves by NASA headquarters and Congress—had long expressed in many ways that they wanted to hear information only that supported their agenda. In this article we have seen how the intimidation by Marshall management and others affected communication:

1. The communication did not take place at all. For example, Ben Powers did not pass along his opinion about not launching to George Hardy, who was sitting across the table.
2. The communication did take place, but if the information did not support what the Marshall managers wanted, they ignored it, rationalized it away, or urged Thiokol managers to reconsider it.
3. The communication did take place, but the information passed along (that it was safe to launch) was not what the engineers closest to the technical data thought was best; it was what the managers at Marshall wanted to hear.

Richard Feynman wrote the following comments in appendix F of the Presidential Commission report:

> Let us make recommendations to ensure that NASA officials deal in a world of reality, understanding technological weaknesses and imperfections well enough to be actively trying to eliminate them. They must live in a world of reality in comparing the costs and utility of the shuttle to other methods of entering space. And they must be realistic in making contracts and in estimating the costs and difficulties of each project. Only realistic flight schedules should be proposed—schedules that have a reasonable chance of being met. If in this way the government would not support NASA, then so be it. NASA owes it to the citizens from whom it asks support to be frank, honest, and informative, so that these citizens can make the wisest decisions for the use of their limited resources.

> For a successful technology, reality must take precedence over public relations, for Nature cannot be fooled. (Feynman 236-37)

Today, the events mentioned in this article are far less likely to occur at NASA. Conditions have changed considerably. Expectations about the launch schedule are more reasonable, most of the managers at Marshall were retired or shuffled out of the way, and the institutional memory of NASA is still full of horrific images of the *Challenger* exploding on January 28, 1986.

There is still, however, little chance of federal employees getting much justice if they blow the whistle. The improved whistle-blowing legislation that was passed in early 1989 does not provide for punitive damages, so the government still has considerable leverage over a federal whistle-blower. Many senior government officials want tight control over the free speech of their subordinates, control that extends to muzzling those employees who want to report fraud or waste. These officials try to invent new techniques to gag federal whistle-blowers.

The destructive—even catastrophic—effects of intimidation on communication can be minimized or even eliminated if managers follow the advice in Winsor's article: Create an atmosphere in which people can pass along both good and bad news, design contracts to diminish the fear of passing along bad news, and "anticipate that [managers and engineers] are probably erring on the side of optimism in interpreting data bearing on already established designs and programs" (107). Winsor's article contains a number of references that advise professional communicators how to achieve these goals.

In closing, however, I must emphasize again that the fate of the *Challenger* and its crew was not decided entirely by the managers at Marshall Space Flight Center. If Congress and a number of other people had not intimidated the managers at Marshall by creating or exploiting the four conditions that I have discussed in this article, the *Challenger* and its crew might be flying today. Works by Lewis, McConnell, and Trento have outlined some of the pressures on the Marshall managers. But the full story of how the Marshall managers themselves were intimidated remains to be told.

## NOTES

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