NASA and the Columbia Disaster: Decision-making by Groupthink?

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On Saturday February 1, 2003, the space shuttle Columbia exploded over Texas upon re-entering Earth's atmosphere. All seven members of the crew died. The accident forced many people to recall the Challenger space shuttle disaster over fifteen years earlier. On the morning of January 28, 1986, the space shuttle Challenger blasted off from the Kennedy Space Center in Florida only to explode 73 seconds later. The death of the seven members of the crew, and particularly teacher Christa McAuliffe, shocked the nation. Unfortunately, the nation learned in the succeeding months that the tragedy could have been avoided.

As information began to emerge directly after the February 1, 2003 Columbia space shuttle explosion, attention pointed to the possibility that faulty decision-making was endemic in the culture of NASA. In a New York Times article, John Schwartz and Matthew Wald (March 9, 2003) suggest that the groupthink that pervaded the decision-making at NASA in 1986 may still be present in 2003 with similarly disastrous consequences.

This paper is an examination of the information as reported during the investigation of the Columbia disaster. We address the question: Does the evidence demonstrate decision-making by groupthink? To begin, we describe the method for our examination and provide an overview of the characteristics of Irving Janis' (1972) groupthink hypothesis.

Method

Based on an interpretive perspective, textual analysis is utilized to examine the reported information made publicly available during the investigation of the explosion of NASA's Columbia shuttle. Textual analysis is a method communication researchers use to describe and interpret the characteristics of a recorded message.

The communication texts examined are articles reported and published by the *New York Times* from February 5, 2003 – August 8, 2003. As the newspaper of public record, the quality and relative objectivity of the reporting during the investigation is reliable. The reported information is disclosed under the Freedom of Information Act. Various other publications are used to validate information and are referenced.

Proceedings of the 2003 Association for Business Communication Annual Convention

Our method involved examining the reports emerging from the investigation of the Columbia shuttle explosion and organizing the reports in categories consistent with the characteristics of groupthink as outlined by Irving Janis (1972). Specifically, we examined evidence of antecedent conditions, groupthink symptoms, and decision-making defects. Following is an overview of the characteristics of groupthink developed by Janis and utilized in this study.

Groupthink characteristics

Irving L. Janis, pioneer in the study of social dynamics, coined the term "groupthink" and proposed the hypothesis after investigating the problems that conformity pressure brought to major American political and military decisions. He stated that groupthink is the triumph of concurrence over good sense, and authority over expertise. Groupthink, Janis said, can be found whenever institutions make difficult decisions. For instance, Janis (1972, 1977) cites the escalation of the Vietnam War and the 1961 American invasion of Cuba (the Bay of Pigs). In his 1982 volume, Janis adds an analysis of the Watergate cover-up decision.

Groupthink, Janis (1982) writes, is "a quick and easy way to refer to a mode of thinking that people engage in when they are deeply involved in a cohesive in-group, when the members' strivings for unanimity override their motivation to realistically appraise alternative courses of action" (p.9). He supports the groupthink hypothesis by analysis of the occurrence or non-occurrence of antecedent conditions, groupthink symptoms, and decision-making defects.

Antecedent conditions
To begin, Janis outlines three primary antecedent conditions for the development of groupthink to emerge: (1) a highly cohesive group, (2) leader preference for a certain decision, and (3) insulation of the group from qualified outside opinions.

Groupthink symptoms
Janis discovered that groupthink tends to occur when several factors are operating at the same time. These factors he called the symptoms of groupthink. Janis (1982) developed three categories (types) with eight specific symptoms.

Type I: Overestimation of the group—its power and morality
1. An illusion of invulnerability, shared by most or all of the members, which creates excessive optimism and encourages taking extreme risk.
2. An unquestioned belief in the group's inherent morality, inclining the members to ignore the ethical or moral consequences of their decisions.

Type II: Closed-mindedness
3. Collective efforts to rationalize in order to discount warnings or other information that might lead the members to reconsider their assumptions before they recommit themselves to their past policy decisions.

4. Stereotyped views of enemy leaders as too evil to warrant genuine attempts to negotiate, or as too weak and stupid to counter whatever risky attempts are made to defeat their purposes.

Type III: Pressures toward uniformity

5. Self-censorship of deviations from the apparent group consensus, reflecting each member's inclination to minimize the importance of doubts and counterarguments.
6. A shared illusion of unanimity concerning judgments conforming to the majority view (partly resulting from self-censorship of deviations, augmented by the false assumption that silence means consent).
7. Direct pressure on any member who expresses strong arguments against any of the group's stereotypes, illusions, or commitments, making clear that this type of dissent is contrary to what is expected of all loyal members.
8. The emergence of self-appointed mindguards—members who protect the group from adverse information that might shatter their shared complacency about the effectiveness and morality of their decisions (pp. 174-175).

Decision-making defects

The result of the antecedent conditions and the symptoms of groupthink is a defective decision-making process. Janis outlines several types of defects in decision making that can result. For instance:

1. Few alternatives: The group considers only a few alternatives, often only two.
2. No re-examination of alternatives: The group fails to re-examine alternatives that may have been initially discarded based on early unfavorable information.
3. Rejecting expert opinion: Members make little or no attempt to seek outside experts opinions.
4. Rejecting negative information: Members tend to focus on supportive information and ignore any data or information that might cast a negative light on their preferred alternative.
5. No contingency plan: Members spend little time discussing the possible consequences of the decision and, therefore, fail to develop contingency plans.

Findings: NASA and the Columbia Shuttle investigation

NASA administration exists at the discretion of presidential appointment with the inherent problems that come with leadership change and political party agendas. In order to keep the space program funded NASA needs to keep the public interested. Shuttle flights and risks are weighed against political and economic risks to keep the program visible. In order to meet deadlines and keep the shuttle launches frequent enough to hold the public interest, NASA provides bonuses to independent contractors for on time delivery. This reward system adds to the complex communication issues that arise and are evident in the way NASA communicates during decision-making. As a result, there is an unwillingness to discuss a problem and people

are reluctant to raise flags that might slow a project and therefore carry political or economic consequences.

Antecedent conditions in the Columbia Shuttle incident

Analysis of the reports of the decision-making by the management team shows the team underestimated the damage during the launch of the Columbia shuttle. The characteristics of the NASA culture appeared to set the precedents for disaster. The NASA Columbia mission management team, chaired by Linda Ham, demonstrated an unwillingness to discuss anything other than an optimistic analysis of the shuttle mission. The team did not investigate seriously any suggestions that the foam insulation (proving to be the physical cause of the accident) could cause serious damage to the spacecraft. The transcripts from the ongoing investigation show a team that was both isolated and isolating.

For instance, Linda Ham, despite being head of the mission management team, reported that she was never officially notified of requests coming from other agencies, while Columbia was still in flight, to obtain satellite images of the shuttle. These satellite images (or images from powerful ground-based telescopes) could have helped identify the extent of damage to the shuttle wing made from the foam debris during the mission launch. Linda Ham reported that she had heard informally about a request for images, but she spent a day asking within NASA and the United Space Alliance (the chief shuttle contractor) and could not find out who had made the requests (Wald & Schwartz, July 23, 2003, p. 2). In fact, NASA administrators had cancelled requests that had come from independent contractors for the satellite images.

Transcript reports also show NASA middle managers in the Mission Evaluation Room, where engineering issues during flight are resolved, reluctant to raise certain issues of importance. For instance, the chief engineer of the shuttle's structural engineering division, in an interview broadcast on ABC, said that he regretted not having brought the issue of the foam debris up at the mission management team meeting at which Ham presided. The engineer said, "part of the problem is that everybody assumed that someone else would do it, and the old axiom of business is no one ever wanted to be first"; in fact, the engineer said, "The NASA culture does not accept being wrong… the humiliation factor always runs high" (Wald & Schwartz, August 4, 2003, p. 4).

During a briefing, Linda Ham had praise for the team and argued that top managers had to rely on the assessments of others. Ham shifted blame though by saying, "I don't have the engineering expertise, nor do I have the tools, to do that kind of analysis" (Wald, & Schwartz, July 23, p. 4). A NASA engineer who worked closely with the mission management team refuted this defense. He said, "It's your job to know the people to ask the questions. Part of it is recognizing your limitations and to push hard for detailed answers to critical questions" (Wald & Schwartz, July 23, 2003, p. 4).

When questioned about the effects of the Columbia disaster, Linda Ham who is married to an astronaut, said that the members of the Columbia crew "are our friends. They're our neighbors. We run with them, work out in the gym with them" (Wald & Schwartz, July 23, 2003, p. 4). Yet, transcripts show a management team that was not attentive to the needs of the shuttle crew. Despite NASA rules that the management team met daily during the mission, this team only held five meetings during the 16-day mission and even took off a long weekend for the Martin Luther King Jr. holiday (Wald & Schwartz, July 23, 2003, p. 2).

This is evidence of a highly cohesive "in-group" where dissenting opinions are not welcomed and information does not flow coherently within or from the outside of the group. The antecedent conditions including a highly cohesive group, leader preference for a specific decision, and isolation from outside opinions, appears to exist.

Groupthink symptoms

Unfortunately, the combination of an aging shuttle fleet, evidence of accident-prone aspects of the technology of the shuttle, a pressure to overestimate the success of the shuttles, and a culture of management that rationalized risks weighed against political and economic measures, suggest that the disaster could have been prevented. Each of the three categories (and eight symptoms), as identified by Janis (1982), is examined in the record of the mission management team's decision-making.

Overestimation of the group's power and sense of invulnerability:

During the investigation by the independent Columbia investigation board (board), a significant shift occurred in weighing the importance of factors that led to the Columbia disaster. Initially the board thought that there was a hierarchy of factors to investigate with the foam debris at the top. Over time a new approach surfaced, as the board chair Admiral Harold W. Gehman Jr. states, "We have what we're now calling either the physical or mechanical failure, and then we have the systemic failures. And we're now putting them at equal weight" (Wald & Schwartz, July 12, 2003, p. 1). Gehman's statement suggests that NASA knew in advance that it had an engineering problem but did not appreciate its significance. According to the board, NASA management had a mindset that "this was an operational vehicle, on an operational mission, and you don't have to worry about it" (p. 2). Admiral Gehman argued that NASA must stop treating the shuttles as "operational" and start considering them as "developmental" (p. 2) This means that each launch should be treated as a first launch, each orbit as a first orbit, and each re-entry as the first re-entry. NASA, Gehman states, has become less interested in details and has allowed its capability to take photographs of shuttles on launching to "gracefully atrophy over the years" (p. 3). This clearly suggests an attitude of invulnerability, where specific safety precautions are allowed to atrophy.

Other management factors reported by the board support this overestimation by NASA's management—a perception of invulnerability. For instance, NASA had sufficient evidence that the shuttle was vulnerable to debris strikes. The flight in 2000 of the shuttle Atlantis went into

orbit with a quarter-inch breach in the wing's leading edge, allowing hot plasma into the wing on re-entry. Engineers knew that the shuttle was being hit by foam debris on nearly every flight, but chose to leave the concern unresolved.

Another management factor is that during the 16-day flight of the Columbia, although scientists realized that foam had struck the shuttle on liftoff and several NASA engineers suggested that the agency should get spy satellite photographs of the shuttle to look for damage, the NASA managers decided against it, even canceling requests. The shuttle launch and flight appear to have been perceived as a routine operation with mission managers not holding the daily meetings required by NASA and skipping days during the long weekend. NASA management was denying existing problems (Wald & Schwartz, July 12, 2003).

Closed-mindedness, rationalization, and stereotypes:
Documents released by NASA on July 8, 2003, provided evidence that the space shuttle Columbia was not the first to have superheated gas invade its left wing on re-entering Earth's atmosphere. The documents show that the shuttle Atlantis also went into orbit with a breach in the wing's leading edge, allowing hot plasma into the wing on re-entry. Responding to the documents, Paul A. Czysz, a longtime consultant to NASA, stated that the Atlantis incident should have put NASA on alert about wing damage (Schwartz & Wald, July 9, 2003). He argued that NASA management should have said, "If that opened up a crack any bigger than the one on Atlantis, we're in deep trouble" (Schwartz & Wald, July 9, 2003, p.1). Yet, an astronaut on the May 2000 mission, Mary Ellen Weber, demonstrated the collective rationalization of the agency and disagreed with Czysz. She argued, "Absolutely, people knew if you have a breach in the wing, bad things can happen. That isn't news. . . Knowing what I know now about gas entering the shuttle's wing, do I believe the mission I was on was any more risky than I thought it was when I took off? No" (p.2). Further, she states, every astronaut knows the risks of space flight, "we may fix this particular problem – but I guarantee the next time astronauts get on that shuttle there will be a thousand other things that can happen" (p. 2). This is an example of the collective rationalization towards the risks of space flight and the way in which problems are overlooked in the race for space.

According to reports coming from independent investigations, NASA's expectations for the shuttle fleet are unrealistic and lack in-depth understanding of the physical conditions of the shuttle (Wald, July 15, 2003). For instance, a study by the RAND corporation states that "given uncertainties about the full set of causes for the loss of Columbia and given unforeseen and unplanned aging issues, it is not obvious that the shuttle system will reach even a 30-year life of useful service" (Wald, July 15, 2003, p.1) Yet, NASA plans to fly the shuttle for 40 years. The study suggests that NASA needs to get a better grip on some of the potential age-related problems. In addition, reports also say that NASA has deferred inspections for corrosion, even though standing water had occasionally been found inside the Atlantis and the Columbia after rainstorms. Corrosion had been found in both the Columbia and Discovery in spots hard to inspect and even harder to repair. At one time, the report states, NASA has a "corrosion control

board," but it no longer exists (Wald, July 15, 2003, p. 2). A spokesperson for NASA replied that the corrosion inspections and repairs had been deferred, but only after engineers investigated the corrosion. The engineers determined that the corrosion was minor and not a safety issue for continuing shuttle flight (Wald, July 15, 2003, p.2). This dialogue demonstrates a pattern at NASA where problems are deferred and then collectively rationalized.

As the Columbia investigation board is discovering and reporting, NASA still does not understand the operation of the shuttle fleet well enough to ensure that future flights would be safe. Yet, Sean O'Keefe, NASA administrator (and a political appointee), said that he hoped the three surviving shuttles could resume flying by December 2003 (Wald & Schwartz, June 13, 2003, p. 2).

Another question, rationalized at NASA, is the cost of risks to human lives. Matthew Koss, a scientist whose experiments were carried out on three missions of the Columbia, wrote in a New York Times article, "In-orbit experiments like mine have been used to justify manned space projects like the shuttle for decades . . . .The truth is that the vast majority of scientific experiments conducted in orbit – including my own – do not require astronauts. . .in fact, experiments like these are often more efficient and yield more fruitful results when done without the involvement of astronauts" (Koss, June 29, 2003, p.1). Koss states that the public image of astronauts as laboratory scientists working on their own experiments is misleading. The astronaut corps, he argues, has served one overriding political and public relations purpose – to sell the space program. In fact, he writes, the International Space Station has been aggressively marketed as a science lab, but the station is seriously flawed in that too much crew time needs to be committed to station maintenance. Further, Koss writes, because of cost overruns and budget problems, the station's crew was cut back to three from the planned seven. Originally, 120 astronaut-hours per week were to be devoted to science; this has been cut to 20 hours per week. Koss argues that scientific experimentation in space can be safer and more cost effective using long-duration remote controlled orbital spacecraft. The overall cost would be significantly reduced because NASA would not need to provide a safe and sustaining environment for astronauts. The point of Koss's article is to argue for the separation of the goal of scientific experimentation from the desire for space explorations. He states, "Astronauts do not risk their lives to perform scientific experiments in space. They fly to fulfill a much more basic and human desire – to experience the vastness of space" (p.3). Koss makes a convincing argument when he writes, "If NASA is not able to convince the public of the importance of science in orbit without astronaut involvement, then so be it. At least America's refusal to support science would be honest, would not needlessly endanger human lives or compromise the integrity of science and scientists" (p. 3). In many respects, this may be one of the prime sources of problems within NASA administration. When is the cost too much in the aggressive effort to sell the space program to the American public? This is a question that NASA does not address publicly.

Pressures toward uniformity - self-censorship, unanimity, discouragement of dissent, and mind-guards: The report by Rodney Rocha, a structural engineer at NASA, is a good example of self-censorship. Rocha tells his story during an ABC *'Primetime' Special Edition* interview on July 7th (Schwartz, July 7, 2003). Rocha states that on the second day of Columbia's mission he saw a grainy video that showed a chunk of insulating foam hitting the left wing of the shuttle 80 seconds after launch. After watching it intensively for days he voiced urgent concerns to colleagues about the need to examine the wing using spy satellites. As this paper has previously stated, Shuttle managers decided against asking for the pictures. Rocha wrote messages urging NASA to "beg" for photographic assistance. Yet, during the meeting presided over by Linda Ham, where management dismissed the problem of the foam, Rocha did not speak up and express his concerns (Schwartz, July 7, 2003, p.2). When questioned about his reluctance to speak at the meeting he responded that he was frightened for his job (p.2). Flight director, LeRoy Cain refutes this statement, "You are duty bound as a member of this team to voice your concerns . . . in particular as they relate to safety of flight" (Schwartz, July 7, 2003, p.2). Supporting Rocha's statement, though, is Adm. Harold W. Gehman Jr., who is leading the independent investigation into the Columbia disaster. Gehman argues that NASA's ability to ensure safety is "very, very shallow" and adds that the system for engineers to express safety concerns is "broke" (Schwartz, July 7, 2003, p. 2). Other members of the investigation board also support this claim and report that by the time of the Columbia mission NASA managers had become complacent about safety and lower-level engineers were reluctant to raise issues that might interfere with a mission.

Decision-making defects

Evidence of both the antecedent conditions and groupthink symptoms help to identify the defects in decision-making. Emphasizing the defective decision-making by NASA management is the statement from Walter Cantrell, a retired rear admiral recently named by NASA to a task force to review the agency's return to flight preparations. Cantrell had worked with NASA before when he helped to conduct a study of the nuclear Navy and compared its processes with NASA's. Cantrell, at that time of the Navy study, identified significant problems with NASA's structure and reported that at NASA, having no independent review of problems allows the possibility of a program manager "tailoring safety technical requirements to meet schedule and cost requirements" (Wald, July 21, 2003, p. 2). Further, Cantrell reported that the nature of NASA's management structure "contaminated the goal of safety with the desire to fly its missions . . . They executed their processes conscientiously, and professionally, but their processes may not be as good as the confidence they placed in them" (Wald, June 29, 2003, p. 3).

In the report to NASA, comparing the nuclear Navy system and NASA's, the importance of an independent technical authority (or review) was emphasized. Cantrell states as an example, "One could reasonably expect that if this problem (the foam) had been given to an independent technical authority, they might not have proceeded until they solved that technical problem" (Wald, July 21, 2003, p. 2). An independent review, Cantrell argues (p. 2), could have found that pieces of foam big enough to damage tiles could do serious damage. Cantrell states that it is

important to be able to separate safety issues from other issues. In this matter, Cantrell suggests that the problem at NASA is that the risk of safety for the shuttles is weighed against the political and economical requirements. This is a significant decision-making factor contributing to a defect within NASA, the lack of outside experts called in as resource persons and encouraged to disagree with the group's assumptions.

In response to the recommendation for an independent review, NASA reports that it will establish an additional safety organization within NASA. Cantrell argues that this solution is not as good as the "closed loop" system of the nuclear Navy program, in which any time a problem is identified corrective action must be found and taken (Wald, July 21, 2003, p.2). NASA's solution might mean another layer of administration without the accountability of each person and without the encouragement to dissent.

The freedom to dissent is another primary element that is missing in the decision-making culture of NASA. As the investigative board study has found, "NASA's flight readiness review system can be an intimidating venue in which to raise a technical issue not fully supported with data" (Wald, July 21, 2003, p. 2). Also, a major obstacle for NASA is the lack of involvement of top management in day-to-day decisions. The Navy, to contrast NASA, conducts most communications by letter and copies of each letter go the admiral in charge of the program. That officer has a tenure of eight years. At NASA the top administrator has a typical length of tenure of four or five years. The NASA administrator serves at the pleasure of the president and so the job often changes when the White House does. For example, the current administrator, Mr. O'Keefe, has shown himself in congressional testimony to be unaware of details of the shuttle program (Wald, July 21,2003, p. 3). In addition, NASA offers bonuses for on-time launches to its independent contractors, a factor that is criticized for raising the possibility of conflict of interest for contractors who must decide which potential problems to bring to NASA's attention. In contrast, the Naval Reactors program has not such provisions for contractors (Wald, July 21, 2003).

Another defect in the decision-making process is reported in the "benchmarking study" (Wald, July 21, 2003, p. 2). This study pointed out that, "knowledge and operational skill degrade when not periodically recalled or used" (p. 2). NASA technicians reported to investigators that there were tasks that they performed only a few times a year and that they were concerned about becoming rusty. Maintaining knowledgeable technicians, outside review, an experienced staff that can question administrators adds to the list of requirements needed to counteract defect decision-making.

Conclusion: Is it groupthink?

As the Columbia accident investigation board continued to collect data, analyze, evaluate, and report its findings, information now in the public record disclosed under the Freedom of Information Act reveals a critical breakdown in communication in the Columbia mission

management team and NASA administration. Information made available through media reports include meeting transcripts, interviews with NASA engineers, and interviews with engineers and administrative personnel from agency contractors. The reports describe a NASA culture that does not accept being wrong and suggests a dysfunctional flow of information within NASA. The reports also describe NASA's approach to peer review and accountability where no one wants to be the first to ask the difficult questions and where upper management does not want to look beneath the optimistic surface of reports of their subordinates.

The evidence in reports of the NASA administration decision-making during the Columbia flight indicate significant defects in the process of communication due to the nature of the management culture and the resulting decisions. Does the faulty decision-making demonstrate the characteristics of groupthink as evident in the investigation of the accident? The first issue to address is whether there is sufficient evidence that the antecedent conditions exist for groupthink to occur.

The public reports clearly suggest that all the antecedent conditions for groupthink are evident. The Columbia mission management team is described as a group deeply involved in a cohesive in-group. This high level of cohesiveness is evident in the group's adherence to the political pressure. No one in the group would raise issues that would question the status quo. The leadership had a preference (and pressure) for a certain decision. The pressure to keep the mission on time/track appeared to weigh more than the cost of asking the hard questions that might result in a delay in the launch. The political and economic risks outweighed the hazards for the shuttle. The members of the management team appeared to be isolated from information coming from outside NASA or from different sections of NASA. The team also made it almost impossible for information that did not adhere to the preferred decision to be discussed. The team lacked a system of checks and balances, isolated from experts who might question the preferred decision. The management team, also, created a climate that made it nearly impossible for staff engineers to raise questions regarding safety issues.

The second issue to address is the evidence of groupthink symptoms specifically overestimation of the group's power, closed mindedness, and pressure towards uniformity. There is sufficient evident that the mission management team overestimated the shuttle successes and assumed a position of invulnerability. Managers knew foam had struck the shuttle's wing, but refused to get satellite images of the shuttle for further investigation. The shuttle launch and flight appear to have been perceived as a routine operation. These examples provide evidence of closed mindedness and rationalization in the investigation reports. In addition, sufficient evidence exists to suggest that the management team created pressure towards uniformity and discouraged dissent among the staff engineers.

The third issue, is the evidence of defective decision-making. The decision-making defects during the Columbia flight become apparent after reviewing the antecedent conditions and the symptoms. For instance, there is no evidence of a survey of all possible alternatives to consider

after the launch of Columbia. There was no re-examination of alternatives after the shuttle sustained damage during the launch. Instead, there was an acceptance of the flight as a routine operation. There was a rejection of expert opinions with NASA actually canceling requests for satellite photographs to view the damage to the shuttle after the launch. There was a rejection of negative information and a rationalization that accepted the damage as routine. Most important, there was no documented evidence from the investigation of any discussion of the possible consequences or for contingency plans.

In conclusion, based on the reports to date, there is sufficient evidence to describe the faulty decision-making during the tragic and final flight of NASA's Columbia shuttle to be groupthink. Richard Covey, a retired Air Force colonel, astronaut, and co-chairman of the independent panel monitoring the resumption of the space shuttle program argues that NASA's management issues are "barriers to good decision-making " (Wald, August 8, 2003, p.2).

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