CHAPTER 9.—LEADERSHIP IN ESCAPE FROM UNDERGROUND MINE FIRES

This chapter explores leadership behavior in a life-threatening situation—fire in a coal mine. Previous chapters have discussed the database of interviews with miners who escaped from underground fires. Researchers raised questions such as: (1) Who led the miners out of the mine? (2) Did leadership make a difference in the escapes? (3) Was the escape leader the hierarchal leader? (4) What, if any, characteristics did the escape leaders possess? Subsequently, researchers analyzed the mine fire database from a group interaction perspective to address the leadership questions posed.

Leadership has been one of the most researched topics of human behavior in the twentieth century. Studies have ranged from individual characteristics of leaders, to situational leadership, to interaction of leader and follower, suggesting different leadership techniques for different followers. The question that emerges here is: Are there different types of leadership that "fit" different kinds of situations? In a crisis situation like that examined in the present study, such information about leadership may significantly improve the chances of escape.

To address these issues, the study team looked at the formal authority structure before each fire, considered leadership behavior or lack of leadership during the escapes, and examined those conditions associated with the emergence of leadership. According to Bardo [1978], "Emergent behaviors are those forms of action, and the norms, values and beliefs governing those actions, that rise out of the disaster situation." This chapter discusses previous studies in the area of crisis leadership and examines the emergent behaviors of leaders under duress during the mine fire escapes.

Previous Studies

The research on leadership during emergency situations has consisted mainly of simulation and field studies, with the principal concern being escape from building fires. During the 1980s, Hayashi [1988] created a computer simulation model to evaluate leader behavior in a fire. Although his purpose was to aid in planning for disaster prevention, his findings are relevant because they address the issue of situational leadership in crisis—where a leader changes his or her behavior to fit the situation. Essentially, his simulation model was designed to judge the actions and thinking of leaders. The simulation was tried by 101 subject/leaders 4 times each. The simulation consisted of a maze containing the leader, an informal leader, and 50 evacuees. Interestingly, the results indicated that the leader's actions were *not* dictated by circumstances. Any differences in behavior were attributed to the *individual characteristics* of each leader. The study also showed that the worse the situation became, the less individual

differences emerged. Hayashi thus concluded that an evacuation plan should not be based or rely on circumstance, but should consider the anticipated behavior patterns of leaders.

Sugiman [1984] and Misumi [1988] conducted field tests comparing two evacuation methods: the Follow-Direction Method and the Follow-Me Method. The studies took place in an underground shopping mall with volunteer escapees and confederate leaders. In the first method, the leader indicated the direction of the exit in a loud voice and by bodily gesture as he moved toward the exit. In the second, the Follow-Me Method, the leader told a few evacuees to follow him and then actually proceeded to the exit. To make the evacuation more complicated, two exits were set up, one not visible from where the evacuees were located. In addition, the lights were turned off and a siren sounded for 20 seconds before evacuation.

In the first study, the researchers found that the Follow-Me Method evacuated people more quickly than the Follow-Direction Method, because a multiple number of small groups formed around each leader. A followup study focused on leader-evacuee ratio, presuming that the formation of groups would be different if there were fewer leaders. It was concluded that when each leader had a small number of evacuees (a 1:4 ratio), the Follow-Me Method was more effective than the Follow-Direction Method. With fewer leaders and a large number of evacuees, e.g., a 1:8 ratio, the Follow-Me Method was not effective because the instructions from the leader did not reach every evacuee.

Misumi and Sako [1982] analyzed leader behavior in emergencies using a laboratory simulation with one confederate leader and four naive subjects. Results showed that if the leader first attempted to reduce tensions and then indicated the direction to take, the subjects followed more closely than if the sequence of behaviors was reversed. These authors concluded that panic is reduced by introducing appropriate leadership.

Hodgkinson [1990] noted that panic typically influences behavior in fires. He defined panic as nonsocial, blind, irrational behavior. His research into almost 1,000 fires, however, found that most people acted appropriately; a mere 5% behaved in such a manner as to increase risk. Johnston and Johnson [1988] studied the behavior of workers in the 1977 Beverly Hills Supper Club fire in Kentucky. They supported Hodgkinson's work in the conclusion that panic is not "automatic" in a disastrous fire and that groups can indeed adjust to meet the increased demands of a crisis.

Sime [1983] noted that most models of escape behavior support the panic model of "every man for himself." The panic model says that people will revert to highly emotional, primitive, self-preservation behavior. Researchers generally have concluded that individuals will panic and try to save themselves at the expense of others *only* when a situation is *extremely threatening*. The panic model "assumes that escape will involve a homogeneous population of individuals

concerned with self-preservation, competing with each other for limited exits" [Sime 1983]. An alternative model studied by Sime focused on affiliation behavior during escape from a building fire. His affiliative model predicts that "individuals with close psychological ties will attempt to escape in groups of two or more" [Sime 1983]. The affiliative model predicts that in life-threatening escapes individuals will be concerned not only with self-preservation, but will experience a heightened concern for other group members.

It is clear that there are two different schools of thought on group interaction in crisis—*panic*: "every man for himself" versus *affiliation or attachment*: "united we are safer." During a simulation study [French 1944, in Sime 1983], subjects were left in a room and after a short period smoke was leaked into the room. The results showed that organized groups of sport teams responded more quickly to the appearance of the smoke than unorganized groups. The presence of other people, and the type of group threatened, influences responses. Further, it has been suggested that attachment or affiliative behavior has survival value [Bowlby 1973, in Sime 1983]. The function of attachment behavior is in gaining proximity, and consequently, protection from the threat.

Sime studied the 1973 fire that occurred at the Summerland seaside leisure complex in the United Kingdom. Of 3,000 vacationers, 50 died when a fire, started by 3 boys playing with matches, engulfed the solarium area. Five hundred accounts of the event were collected by police. In analyzing the data, Sime targeted four areas: group membership, attachment at cue (cue: signal of the fire), nature of cue (example: ambiguous, unambiguous), and affiliation at exit. The results strongly support the affiliation model. Sime concluded that:

> In an entrapment setting people maintained as far as possible their ties with close relatives during escape. In normal evacuations people are likely to maintain primary group ties. These psychological ties will become even more important rather than disappear in a fire emergency.

Kelley et al. [1965, in Sugiman and Misumi 1988] demonstrated the importance of the emotional aspects of panic. Subjects were placed under a time pressure and could avoid an electric shock by depressing an escape switch which only worked if other members of the group were not pushing theirs. The researchers showed that a sign from one or more subjects indicating they would wait for others to escape increased the number of successful escapes for the group, i.e., cooperation increased the chances for effective escape. Hodgkinson [1990] recognized that the interaction among people is important when there is a choice of exits because people tend to follow the route others are using.

Familiarity behavior in disasters seems to extend beyond affiliation and escape routes. Johnston and Johnson [1988] hypothesized that disaster roles assumed by individuals within an organization are extensions of the ordinary,

everyday roles they normally perform. Johnston and Johnston were interested in what organizational roles could be expanded to include disaster-related responsibilities. They concluded that the routine roles of individuals were extended in a crisis and thus the social order was maintained. Canter [1990] echoes this thought: "The social behavior and cognitive processing of individuals stays remarkably close to what can be seen in ordinary, daily behavior." Thus, familiarity with organizational roles affects the ability to survive.

Abe [1976] analyzed the behavior of survivors and victims of a fire in a department store in Japan. He discussed three behavior patterns each, of survivors and victims. The analysis concluded that survival behavior can be more effective with prior knowledge of an area. The research also found that people often return to the familiar and to habit in times of crisis (e.g., they will return to a familiar area). This supports Sime's finding that the tendency of individuals and groups to head towards a familiar route is likely to increase during fires. Abe noted that, in a crisis situation, people lose flexibility. In addition, Abe found that in an unfamiliar place, under dire circumstances, many subjects decided that the only and best thing to do was to follow the person in authority. In this particular department store fire in Japan, this was an unfortunate decision that resulted in the deaths of many subjects.

Although the majority of research has been on individual behavior under stress, with group interaction as a secondary research focus, there is some information on what happens to formal organizations versus small groups under stress. Driskell and Salas [1991] suggest that organizations under stress tend to centralize authority. Decisions move to the upper levels of the hierarchy. A study of small groups under stress, however, found the opposite phenomenon: the group leaders and group members became more receptive to information from others.

The research on the concept of leadership is vast. As Warren Bennis noted, "Of all the hazy and confounding areas in social psychology, leadership theory undoubtedly contends for top nomination. And, ironically, probably more has been written and less known about leadership than any other topic in the behavioral sciences. Always it seems the concept of leadership eludes us or turns up in another form to taunt us again with its slipperiness and complexity [Smyth 1985]."

Holsti [1990] wrote a chapter on crisis management in the book *Psychological Dimensions of War*. Although the focus situations of the text were political crises, not natural disasters or fires, Holsti's observations about leadership in crisis are a propos to further understanding the leadership concept as it applies to escapes from mine fires. The author cites observations of leaders in action that "appear to confirm the conventional wisdom that in crisis decision-making, necessity is indeed the mother of invention." In the mining industry, most underground workers can attest to the necessity of "invention" on a daily basis in their dangerous work environment.

In a study on perceptions of leadership traits, Morris [1991] compared adolescent and adult leaders. He concluded that "integrity and knowledge or skills, are traits of leadership highly valued" and that "effective leaders have positive identities." He characterized them as self-assured, self-actualized, honest, open, and trustworthy. Another valued trait was knowledge or skills. The adults in this study considered consistency and flexibility important components of leadership, a finding that suggests a practical, pragmatic, and realistic approach to problem-solving situations.

In conclusion, the research on leadership during crisis has shown that (1) the importance of studying leader behavior patterns [Hayashi 1988], (2) leaders can have a calming influence and be instrumental in helping others avoid panic [Misumi and Sako 1982], (3) panic is not automatic and indeed individuals have a tendency to follow the prevailing social order [Hodgkinson 1990; Johnston and Johnson 1988], (4) people tend to follow the routes of others and familiar paths [Hodgkinson 1990], (5) attachment/affiliation may have survival value [Sime 1983], (6) cooperation contributes to successful escape [Sugiman and Misumi 1984], (7) people lose flexibility in life-threatening situations [Abe 1976], and (8) information/knowledge can be significant to survival [Abe 1976].

Finally, it is important for the reader to recognize that simulation exercises on human crisis behavior raise ethical issues. Exposing subjects to the threat of electric shock, or an appropriate degree of threat to evoke the panic and fear necessary for accurate data collection is a concern in this type of research. Furthermore, disaster circumstances are unpredictable. Subjects who have faced some type of threat subsequently must be questioned carefully because of the possibility of emotional trauma coloring their responses. In analyzing the data from the mine fires, researchers focused on the behavior and characteristics of leaders from the view of the survivors, official reports, and circumstantial data evaluated after the event.

Profile Characteristics

In the three mine fires studied, there were eight groups of miners that escaped. For each group, a profile of leadership in crisis emerged from the analysis of the eight mine fire escape scenarios. The data suggest several characteristics based on the behavior of the leaders. The leader of each escape may be described as an *aware, knowledgeable* person or as an individual who is alert to his environment, attentive, and discerning. Typically, this person notices details—more so than do other people. The researchers believe that this quality of discernment probably is not limited to the mine environment or to crisis circumstances, but is a typical characteristic of these individuals in all circumstances. Such persons may also excel at incidental learning. Each of the leaders retained information that was instrumental to the escapes. They

"remembered" specific details and repeatedly referred to the fact that they "knew" what they were doing through information or deduction.

A second generally shared characteristic of the leaders was the manner in which they took charge. In groups where the regular authority led workers out of the mine, leadership was a natural evolution of group dynamics. It was a continuation of the social order before the fire. A similar dynamic occurred, however, in groups where a definite leader emerged. These emerging leaders did not "muscle in and take charge"; the leadership *developed in a natural way*.

Third, the leaders were *decisive, yet flexible.* They made decisions; yet if circumstances changed they adapted.

Fourth, leaders were *open to input* from others. There is evidence that in most of the escape groups there was a "second lieutenant," an individual who offered worthwhile suggestions, support, and who served as a "sounding board." In instances where there was emergent leadership, the leader usually began in a consulting function to the regular authority.

Fifth, effective leaders seemed to have a *calming* effect on their group. They were aware of others' fears and offered reassurance when it was needed. Miners in each group had *confidence* in the leader's ability to direct them to safety. Finally, there was a *logic* to the leadership. Decisions were appropriate and congruent with available information.

Findings

Each of the group escapes was unique, but some consensus crisis leadership characteristics emerged. Technical descriptions of each of the eight escapes are contained in appendix A. Specific details relative to leadership issues are discussed and supporting evidence for the profile addressed above are organized according to section and mine.

1 Right - Adelaide

This group was a production crew with a new section foreman who was unfamiliar with the affected area of the mine. In fact, the night of the fire was his first night back in the mine after a 5-year absence. In addition, at least three members of the crew were new to the section. While each of the new members had many years of experience in mining, all had been assigned to this crew for only 3 weeks.

The foreman, although the authority figure, did not lead their escape. His behavior was initially appropriate in that he assembled everyone and called the dispatcher with a proposed escape route. He also called back to the dispatcher when the escape route was changed. As the group entered heavy smoke, the foreman simply did not have the knowledge base to make appropriate decisions.

The group was accepting of the foreman's inability to lead in the situation because it was obvious he could not possibly have the appropriate information on his first night back at the mine. The miner operator from the section gave his view: "The boss, I can't blame the boss. This was the first time he was on the section in 5 years." A utilityman from the section expressed a similar sentiment: "It wouldn't have been [the boss's] fault, it was [his] first day in the mine."

> It was also clear the crew was protective of this authority figure:
> I'll say he [the boss] did all he could. He did the best he could. He led us, you know, to the fresh air escapeway. He made sure we got through into the return. But as far as being well-versed in the mine, I don't know. There again, I'd really rather not have to make a statement.

On the night of the fire, a former fire boss was working as the continuous miner helper on this section. The position of fire boss had required him to travel throughout the mine, thereby becoming familiar with the mine layout, including the escapeways. As the group's escape progressed, this former fire boss emerged as the leader. Interviews with other members of the group documented this leadership. The former fire boss began his emergence as leader by consulting with the authority figure, the section foreman, making suggestions and advising on alternative actions. The fire boss viewed himself as working *with* the foreman. When directly asked in his interview who led the group out, he responded that although probably the other members of the group would suggest he did, actually he and the foreman led the group out. A bratticeman indicated that the fire boss "was saying what we could do" and the foreman was "like making the decisions." When asked if there was any confusion among the men about leadership, the bratticeman said, "It was pretty much follow [the fire boss] and the boss."

After sizing up the situation, the fire boss suggested that the group might escape by traveling through the bleeder entries to Peterson Shaft on the other side of the mine (see figure 2.1). This suggestion was not accepted by the group, and he chose not to push the idea. Instead, the fire boss explored other possibilities with the group. His behavior at this point indicates decisiveness and flexibility of thinking in crisis. The fire boss said:

> You know, I was thoroughly against going down it. But like I said, I knew, you know, I wasn't going to go by myself down there. If I'd have had to, I would have. If I'd just been by myself, I would have went across. But I knew half them guys would want to walk right into a bleeder. I knew they would...and so I stuck with the guys.

In short, the fire boss tried to get the miners to go deeper into the mine to explore another exit, but because they had only one frame of reference—to "get

out"—they could not conceptualize going farther into the mine. The continuous miner operator said "[the fire boss] wanted to go back but nobody said, yeah, let's do that. I think their main concern was, let's get out."

At this point, the group entered the left return airway of the section. Just after getting into the return, the fire boss had trouble with his self-contained self-rescuer (SCSR) and told the group to go on ahead, figuring that they would know where to go from there. A few moments later, several members of the group got lost by following reflective markers they thought led to an escapeway, but in fact marked a bleeder entry examination route which led to another part of the mine. The fire boss had to reassemble the group and told them:

> Keep the stoppings to your left...if you don't see one, go over till you do find one, and then always have the stoppings to the left of you...I told them, ignore the reflectors, because you are going to get lost.

This advice is an example of this leader's awareness of the mine environment.

It was clear by the conclusion of the group's escape that the fire boss was in charge. When one miner did not come out into fresh air with the rest of the group, it was the fire boss who said "we will go back for him" and went back into the smoke with two other miners to look for their missing buddy. "You couldn't see nothing...They [two other miners] said they wanted to go back with me. So we went back." Because of the thick smoke, the fire boss told the two miners with him to hang on to a water pipe as they worked their way back to where they believed their buddy became lost. At strategic locations, the fire boss positioned the other two miners with him so that they would know where to make turns to get back out. Again, he took the responsibility of leader, utilizing his knowledge and giving directions. Everyone in this group successfully evacuated the mine, even though the missing miner followed another route of travel with which he was familiar.

2 Northwest Main - Adelaide

This group, a production crew, was alerted to the fire, gathered together under the foreman's direction, and rode the mantrip until they entered heavy smoke. At this point, the foreman decided to take the crew back to the section and over to the intake escapeway. As they proceeded out the intake escapeway, they encountered smoke again. The foreman then led the crew into the right-side return aircourse, which was also the secondary escapeway. Again the crew encountered smoke. At this time they donned their SCSRs and proceeded out of the mine on foot through the return escapeway. This crew epitomized the value of correct procedures in evacuation and basically escaped without incident. A bolter operator from the section summarized the group's experience:

> We were about as organized as you're going to get. We did real good. We have a mine rescue man that's been on mine rescue for years. He was with us. He's our buggyman and we had the boss and the mine rescue man set it up, the boss in front, he was in the rear. The crew was in the middle. Worked fine, no problem at all.

The authority figure, the section foreman, was the leader and worked with the "second lieutenant," the individual with mine rescue experience. The crew viewed "the boss and the other guy" as the leaders, and the two men saw themselves as working in tandem. When asked who made the decision to put on the SCSRs when they ran into smoke the second lieutenant answered:

> Well, like I say, ...maybe we hit it together, simultaneously, let's say, hey, ...we got to get these people on their oxygen now!

The only problem this group experienced occurred when the miners put on their SCSRs. One miner felt his SCSR was not functioning. The leader dealt with this problem by offering to trade SCSRs. The continuous miner operator described the situation:

> That one guy was nervous. He didn't think his worked right. I remember the boss saying, well, do you want mine then? Because there was nothing much the matter with it. He was just being nervous.

Another man became panicky when his rescuer also appeared not to work. The second lieutenant calmed him, blew into the apparatus to start it, and said, "It's just like kissing you, you old bastard." The leader also made the group slow down so that they did not need as much oxygen and would not overwork the apparatus. A bratticeman described his experience:

> And it seemed like the harder you used, you know, it seemed like you wasn't getting the right amount of air out of them. But then [the boss] said, just slow the pace down.

This knowledge of the operation of the SCSRs and consequent adaptability of behavior is a quality of an *aware* individual.

The leader's behavior also had a calming effect on the crew. This calming was evident in the interviews with the subjects from the group. When asked if the group stopped along the way, several miners commented:

> Yeah, we stopped different times—one guy fell down. I pulled him back up. He fell down. He was a little red and hysterical there a little bit of the

time. And we stopped and the boss talked to him and calmed him down. We stopped periodically, if anybody was having problems. We'd stop and check. Not long, but long enough to talk and see where to go and calm down.

And like I said, the boss, between him and whatcha-call-it, he more or less kept everybody level-headed, you know, like, well, at least not have no panic and everybody take off, you know.

The boss said, "We got to put these (SCSRs) on fellows. This is no drill. Put them on but everybody stay calm, and we'll just take our time and we'll walk out. We'll be all right."

We all stuck together real well. You know, if I got too far or [the miner who] was with me, he'd get out in front of me and if we got too far, the boss or somebody just said, take a break and the one guy was having trouble and he said you know, that he needed to rest some and we just stopped and rested with him.

The leader of the group who was also the authority figure was decisive, logical in his leadership behavior, had a calming influence, and was knowledgeable. All members of this group evacuated the mine without undue difficulty.

3 Left - Adelaide

Most members of the production crew making up this group had been working together for some time. There were three new members on the section the night of the fire, but each was an experienced miner who had worked in other sections of Adelaide Mine. A utilityman who had been with the crew since the section was started noted:

We had some people come and people go, but the majority had been together for at least probably 2½ years.

Despite their history of working as a crew, these miners did not escape as one cohesive group. Instead, they spread out forming a fast subgroup, a slow subgroup, and by the end of their evacuation there were two miners in the middle.

After learning of the fire, the section foreman warned the crew and they gathered at the dinner hole. At this point, most of the miners did not think that they were in danger:

> That did come up, how it (the belt) could catch fire when it wasn't running. You know, but still that hasn't sunk into us that it was burning that hard.

In contrast to other groups where the foreman attempted to calm the miners during the escape, this foreman tried to impress upon the group the seriousness of the situation. According to the utilityman:

> The foreman said, "Hey, look, this is serious shit. You know, we got to get out of here." And then everybody started saying, well, maybe it is burning that hard. But it was still hard to believe it was.

The crew began their escape by traveling outby on the mantrip. When they encountered smoke in the track entry, the miners got off the mantrip, distributed the SCSRs, and planned on going into the intake escapeway. At this point, some miners "took off" and the group began to separate. One miner commented:

> They started passing the self-rescuers out and everybody just started taking one and that's how...we got spread out.

The front group saw themselves as leading the way:

> So we were more or less in the front, leading the way and the foreman was back with some of the other people...We were the ones that were picking the escapeway out.

When the miners hit smoke in the intake escapeway, they moved to the right return aircourse which was the secondary escapeway, but still had to contend with heavy smoke. The crew continued down the return and crossed one overcast. At a second overcast, the group experienced fear beyond that of any other escape group:

> I was the first one there. I had like one guy on either side of me, walked up there to the overcast and I stepped right into it. And it was like a black wall. It was like burning fifty tires and trying to walk through it... And I said we can't go that way. So we walked out and there was some—I know there was doors in those overcasts. I said, the intake's here someplace. All we've got to do is find it. And you'd open up the door and it'd just billow out; and you'd open up another door, and it would billow out. And that's when we had a little team meeting; that's when people really started getting tight. It was like, which way do we go?...And I remember asking the foreman as we opened up the door, it

> looked like it was a black river running by. That's how thick it was. And I said, "Was that the intake?" He said, "Yeah," and—it's not real registered in my head—I remember, "It can't be! It couldn't have burned through already!"

The amount of smoke in the intake and other aircourses led the miners to believe that all exits were blocked by fire. In this case, knowledge about the mine and its ventilation patterns hindered rather than helped those miners with this information. It was later discovered that a door had been left open and the smoke was not following the usual mine ventilation pattern. At the time of their escape, however, the crew had no way of knowing this and logically assumed the fire was blocking all exits.

The group then walked back into the mine, toward the faces, searching for a door into another entry. Near the mouth of the section, the miners in the became lost. The miner operator said:

> We got confused and started going back into the section till we run into the first door and we just made a complete circle and come right back to that main overcast again.

It is important to note that the boss was not in the lead when the group got lost; the group in the front had gone off in the wrong direction.

The crew stopped, realizing that they were lost. The foreman probably figured at that point that the fire was between the crew and any chance of escape. With a door left open, the smoke was entering areas of the mine that "made no sense." In this situation, the foreman's knowledge of the mine confused him because seeing smoke in the return indicated to him that the whole mine was on fire, or at least fire was blocking all of the exits. It appears that this analysis made him too upset to make a clear decision on the direction to travel. The miner operator yelled at the foreman, telling him to calm down so that he could think about their escape:

> Then I myself told the boss—I said, "[Boss], get your composure and get us the hell out of here. We're all scared you know."

The miner operator continued, explaining that at this point the section foreman pulled himself together and demonstrated his knowledge of the section and his awareness of his surroundings, saying:

> "This pile of dirt shouldn't be here." I think he said right or left—I don't remember—but he said, "This pile of dirt shouldn't be here."

This information was all that was needed to point the group in the right direction.

After getting back on track, the front subgroup took off again. The section's utilityman seemed to take charge of this subgroup to some degree. He was the individual who initially asked questions and made suggestions ("Can't we do this, can't we do that?") and potentially could have filled the "second lieutenant's" role, but did not. Instead, this person went with the faster miners and left the foreman and slower people behind.

As mentioned before, the front group saw themselves as leading the way. The slower group, however, did not see it that way. The miner helper said:

> I told them come on, why don't you guys wait for...One of them said, "This is every man for himself." People were scared, do you know what I mean?

One of the bolter operators commented:

> Everyone was together. Then when we got to the return, why someone just took off, you know, never waited on anybody. They panicked and got scared. That's the worst thing in the world to do. Everybody should stick together.

Toward the end of the escape, one of the roof bolter operators was having a great deal of difficulty and the slower group stayed behind with him. The operator's buddy described what happened:

> I was the last one in line and [the bolter operator], I don't know how old he is, he's probably between 55 and 60 years old. I don't know, but I could hear him starting to have trouble breathing in his device (SCSR). And it sounded to me like he was hyper-ventilating himself. He was trying to out-breathe the device. That's what it sounded like to me. I talked to myself, this man is going to go down and when I started to think that he did go down. He fell onto the ground and I spit out my mouthpiece on my unit and I hollered as loud as I could, I need help here. This man's down. Only two people came back. I said there was either 9 or 10 of us going out in a single-file line and I was the last and I hollered as loud as I could and only two people came back. That was the boss and [another miner].

This splitting of the crew resulted in two miners finding themselves in the middle, between the faster and slower groups. Neither heard the bolter operator call for help and did not know a man was down. These miners continued on, as

did the faster group, unaware of the problem behind them. All of the miners eventually continued out to fresh air.

The section foreman, the authority in the group, started out in control but eventually lost it and never recovered the authority position with his group. The utilityman characterized the foreman as:

> Excitable...yeah...but he's not to the point of panic or anything like that. He still keeps his composure about it but he's kind of a high-strung guy. That would be more of a term to put on him.

Continuing later in his interview, the utilityman said:

> I do remember the boss was quite excitable and I remember the miner operator telling him, "Now, you're a foreman. Get your shit together. Now where the hell are we at?"

Instead of any one person fulfilling the role of leader, various members of the group displayed some of the characteristics of a leader. The foreman took control of the situation initially and used his knowledge to get the group back on track after they had become lost. The utilityman seemed to assume some leadership of the faster subgroup and directed them to don their SCSRs. When the foreman seemed to be losing his ability to make logical decisions, the miner helper calmed him down. At another point, one of the bolter operators took the lead and went to explore the way over an overcast. A bratticeman on the section that shift, one of the two miners in the middle, assumed the role of assisting the other, who was older and having some difficulty.

The dynamics of the escape for this group were foreshadowed when the SCSRs were distributed and people simply took off. One group member explained the lack of discussion saying:

> Our crew, most of them have a good bit of time in the mine and it was just—as soon as we run into smoke, that was the first thing everybody thought, get into the escapeway.

Throughout the escape, no one person was looked to as the leader. When queried as to who was making the decisions, the miners of this group provided various answers, resulting in no consensus.

4 South - Brownfield

This group consisted of a production crew plus a mine inspector who was in the section the day of the fire. The authority figures in this escape group were the section foreman and the mine inspector. As it happened, these two individuals knew each other and jointly led the escape. The section supplyman commented:

> The boss and the inspector was there, and they were discussing which way to go—which would be the best way to get out. So they decided it would be down the belt. We all went down the belt.

This group, like the 3 Left crew at Adelaide Mine, had a split escape but with dynamics and leadership characteristics dissimilar to those of 3 Left crew. The major problem in the faster group, led by the foreman, was with breathing through the SCSRs because they were moving so fast. The slower group, led by the inspector, had a miner who experienced breathing problems and was continually falling down. Toward the end of the escape, he fell a final time, was left behind by the other miners, and was later rescued.

The foreman felt and assumed responsibility for the men but was strengthened by the support of the inspector. An indication of how well the two men worked together is found in both of their interviews. The inspector, when asked who was in charge, replied:

> I didn't feel like I was in charge, [he] is the section foreman but anything either of us said or did, I've got a lot of respect for [him]. I know [him]. Anything he said I didn't question. Anything that it appeared I said, he didn't question and anything that either of us said wasn't, like I said, there was never once any talk. Even when it came down to who's going to go with the fast men and who's going to go with the slow men, there was never no discussion. It was just one of us said what we'll do, and we did it.

Commenting on his leadership role, the section foreman noted:

> Well, I'm responsible for them. I didn't want them splitting up. I was glad the inspector was there because I felt he's going to watch these people and I'm going to watch the other group...I wanted to stay in the back and know where my people are. That was my first concern. I just didn't like the idea, but didn't want them taking off the way they were. I was afraid, you know. I can't sit on them.

The above explanation documents that the foreman was decisive, yet flexible. During the escape, some of the men began to take off and the foreman was concerned, yet aware enough to know how frightened the men were. The inspector understood the dynamic too, and although against accepted "evacuation policy" of not splitting up a group, considered the decision to allow the faster men to go ahead with the supervisor.

The manner in which the inspector, who functioned as the "second lieutenant" in the group, communicated the fire to one of the crew is evidenced in the following comment from a bratticeman:

> So I started to pick up my tools. He [the inspector] said, "leave the tools behind, don't worry about them, let's get out of here," and with his advice and his quickness and alertness, I became aware that it was serious.

Initially, some of the miners took off immediately ("they ran like deer"), but were stopped by the supervisor who "made them wait till everybody was there so we had everybody before we started." Both leaders responded calmly.

It is interesting to note the behavior of the inspector when the man in the slower group continued to fall:

> I know at one point...I said let's stop and take a minute and the man is sitting there and the mechanic was still with us and I recall looking at my watch, and I thought we had been under oxygen, I believe, it was 20 minutes at this time and I knew we still had a ways to go.

The inspector was continually evaluating the situation and reasoning alternatives, similar to the other group leaders. This same individual made a prophetic observation when the men were first putting on their SCSRs:

> I looked around to make sure they were starting to put theirs on and when I looked over and saw the bigger man—that's about the first time I started getting a little worried because he was shaking somewhat severely, his hands were, you know, very noticeably trembling and I just thought to myself, "Oh, boy." I said, "I think we are going to have trouble because he's having a hard time."

This miner was a large man who weighed in excess of 250 pounds. When he went down the final time, the inspector was in a serious dilemma:

> I don't recall how far, but I know I was struggling with this man and I know he was making me tired and I hadn't had any problem up until

> this point but when I looked down, I realized the bags in my SCSR were flat and I know here again I thought, boy, there was no discussion about it, but the section foreman and those other guys, they're probably way ahead of us by now and here I'm back here with this guy and he having all this trouble and now I'm having trouble breathing and breathing was getting harder and harder. I didn't think to look at my watch, but I didn't know, had I exhausted the machine (SCSR) or was I running the same problems as this man? I was using more, you know, demanding more out of the machine than it was giving. I knew I was working a lot harder now and I started getting concerned about that now too and I guess we continued. I continued with this man. We finally came to a high spot and, like I said, I was still having—I was taking as much outside air in as I was out of the machine...I realized how this man is now because my machine is not giving me air or what, but when we got to the high spot, I knew exactly where we were because from traveling the belt, I knew we were at the intake over where they had cut the overcast for the intake and the man that was having so much trouble, he's down again. He looked at [the mechanic]. I saw him look at [him] and he said, "You guys go. You just leave me here." He said, "I can't go no more." He said, "I'm just going to stay here." I looked at the other guy and I said, "I got to go." I said, "There is no sense in me staying"...I said, "I can't breathe now." I said, "I know where I'm at. I can send somebody back. I'll go out and get somebody."

In desperate circumstances, the inspector continued to follow what seemed to him a logical path. In recounting his story, the inspector noted that although he would like to have thought he was in control, he realized he was not. Each leader had taken an extra SCSR. Although the inspector was running out of oxygen, he forgot he was carrying an extra SCSR ("Maybe I'd taken too much smoke.") This point emphasizes the severity of the situation. The inspector got to fresh air, saw the foreman, and told him of the miner who was down. The foreman said, "He's my boy," and went back in for him. In the meantime, the miner who was down was left alone. The final person who had been trying to assist this miner decided he was:

> Not going to make it, I'm going to try and get out. So I started out and I was only about a hundred foot from [him] when I came through the overcast and I opened the door and I saw No. 7 and I thought, good, this is fresh air, or this is a, you know, the way out...So I thought, "Well, I'm going back in to get [him]."

Actually, this miner was mistaken about his location. However, while he was trying to convince the miner who was down that they could reach safety, the foreman arrived. Together they got the miner going again and out of the smoke. Everyone was then accounted for.

Several leadership questions emerge in relation to this group: Should they have come out together? Should the leaders have insisted on more unity, or had better control over the group to facilitate a cohesive group evacuation? The inspector responded to the inquiry about split groups by stating that there were two individuals who could show leadership and if you have two groups, "don't hinder the one group because of the problems of the other group." Clearly, despite the split escape, there was decisive leadership by both individuals in this group.

5 South - Brownfield

The group, a production crew, was led out of the mine by their section foreman and a roof bolter operator. A shuttle car operator remarked:

> [The foreman] is our boss. He knew—he done right. He got us on the right track and kept us on the right track. Between him and [the bolter operator].

Again, the leadership in this group was basically the authority figure, with the particular assistance of one of the men, a roof bolter operator, but with input of others. This group, after an uneven beginning, ultimately stuck together, even though there were several older miners in the group and one person who had continual difficulties breathing with his SCSR.

After being alerted to the smoke, the crew assembled and began its evacuation. Two miners, both bratticemen, ran ahead of the others in the group. A bolter operator noted that one of the men said at this time:

> "Come on, let's go. We got to get out this way." And he took off. Well, he took off and went down like—and he was leading the pack, okay. When we got down to where the regulator was at and put the self-rescuers on, you know, that's when [the boss] took over. But that's one of the things that I told [him] later on, I says, "You're the boss. One thing you got to do if this ever happens again, you should have a man that's in charge that's going to take his time and walk out of there slow and easy with his SCSR on."

In the course of the escape, the bolter operator assumed the role of advisor to the foreman. One miner explained why the two men took the lead initially:

> See, bratticemen know pretty much what's going on, where everything is at. I'd say the two bratticemen up there pretty much took the lead out—pretty much took us out.

When asked who took the lead in the group, one of the bratticemen said:

> Well, me and my buddy, 'cause we knew everything, every place up there. Some of the bosses don't know their way around, and I've been in that place for eight—near nineteen years.

Both bratticemen felt they had the knowledge to lead, yet they took off, traveling too fast for the group. They were unaware of the needs of other members of the group and the surrounding circumstances. This behavior is not characteristic of effective leaders. In this case, the foreman stayed in the back to assist the slower individuals.

At one point, the foreman left the slower miners to check the mandoors ahead hoping to find clear air. As the foreman opened one door, he saw thick smoke:

> Right then, panic hit, believe me. 'Cause all the teaching and training everything, these are all supposed to be separate splits. Well, the first thing that goes through your mind is everything is burning. In my opinion, there was no sense in even trying to get [out, but] you're still thinking—so I come back.

This leader, although voicing his consideration of giving up when he thought the whole mine was on fire, rapidly moved on to explore alternatives ("you're still thinking").

When the foreman returned to the group, the group members were panicky. He felt everything was out of control at that moment and he knew the group was in trouble. The men had decided that they would wait only 10 minutes for him to return, indicative of the anxiety and the need to "do something".

> I told the guys, I said, you guys want to try to make it over there and before I said much more...the bratticeman said, "We're ahead of the smoke. Let's go." Well, right then—well, everybody seen the smoke here. That's when there was not much control, you know, everybody started just going.

Again the group spread out somewhat, the foreman staying behind with the slowest group members. The section foreman responded when one of the men "took his self-rescuer off and threw it out. [The man] said he couldn't breathe

out of it, so I helped him get the little one (filter self-rescuer) off his belt and got it open. He couldn't even open that one, but he got to breathing in it."

The leader of this group made sure everyone was supervised during the escape by taking a position toward the back of the group. He was concerned about the slower men and about someone going down. When the group entered fresh air, everyone was accounted for.

6 West - Brownfield

This group consisted of three individuals, including a maintenance foreman and a mechanic who usually worked together, plus a State mine electrical inspector. The only interviewee from this escape group was the maintenance foreman, who assumed the leadership role. The mine inspector, although an outsider, represented authority and at first exercised that authority. When apprised of the fire, the maintenance foreman initially wanted to ride out on a mantrip, but the inspector said no. When asked about the inspector's reason for this, the maintenance foreman said, "Well, it could cause an explosion he said, for one thing. I mean, we were on the damn thing when he says no."

The maintenance foreman, the authority in this group, went along with the mine inspector until the group hit heavy smoke. He then decided the appropriate escape route and "they never disagreed." When the group encountered the heavy smoke they searched for a mandoor in an overcast but could not find it. The maintenance foreman knew they had to go back and he told this to the other two men:

> I knowed where I was going here in this case, so I mean I knowed exactly where I wanted to get to.

This was an important moment in the leadership dynamics of the group, a natural evolution based on knowledge, logic, and decisiveness. The maintenance foreman continued:

> I mean, the inspector, when I turned around and said, "We got to go back," he says, "No," and I says, "You can do what you want to do, I'm going back." I said, "You can follow me or do what you want." At that point I didn't give a damn who followed me or who didn't. I was getting out of a heavy concentration.

It is interesting to note that the next day the maintenance foreman returned to the area of the mine to find the door; it was there where he "knew" it should be.

The maintenance foreman did not lead thinking only of his own safety. During the entire escape he was attentive to the rest of the group. He said:

> I was in the lead all the while and I mean, I knowed they were in back of me. I mean, if one of them would have dropped back, we would have gone back and got him, or tried to anyway.

This leader had a critical piece of information that none of the other groups had: he knew exactly where the fire was. When the fire boss called to alert them about the fire, the maintenance foreman had asked where the fire was:

> I was the only one out of the guys that knowed where the fire was...and the reason for that is I took and asked [the fire boss] where the fire was.

The maintenance foreman was the only person in all eight groups who knew the exact location of the fire and knew that the group had to travel past the fire to escape. He also knew that the return aircourse was double timbered; there were two rows of posts supporting the roof. He was aware that as long as they walked between the timbers with the beltline on the left, they would pass the fire.

At one point in the escape, this group was passing under an overcast and heard footsteps overhead. It was the crew from 5 South:

> I heard them coming over the overcast, and then I was relieved a little bit because I knowed that boss coming with that crew was real familiar with the mine. I was familiar with it, but not like him.

Knowing that the other crew was going in the same direction increased the maintenance foreman's confidence. The three individuals in this group then continued down the 6 West return aircourse to safety.

7 Butt - Cokedale

This group, under the supervision of a construction foreman, was assigned to relocate a power center on the section. The construction foreman, the authority figure, took charge and led the group out of the mine. Although this group experienced some problems during their escape, the group members never lost confidence in their leader and his ability to manage a successful escape. This individual had set up the ventilation for the section and, according to a motorman on the section the night of the fire, the foreman "knew which way to go...we just followed him 'cause he, he knew the area." A mechanic working in the section said:

> I felt pretty confident though because I knew [the construction foreman] had been up there for a long time walking returns and this and that and he was real familiar with the area.

The construction foreman was aware and knowledgeable as evidenced by the comments of another mechanic on the section:

> We were lucky because we had [the construction foreman] and he just spent a whole, he probably just spent 6 months in that return, posting it and cleaning it up, so we really didn't have any trouble with the return and we basically had enough knowledge of the area.

The leader himself indicated his knowledge of the mine in that everybody:

> Was asking me where we were at, what direction we were headed. And with the information that I had, because the biggest part of this I set up; the ventilation, the overcast and so on, the return escapeway. And I knew first hand, you know what direction we were in, where the mandoors were at.

The group's faith in the foreman continued even when some major problems were encountered early in their evacuation. When notified of the fire, the construction foreman gathered the group together and the crew began their escape in three vehicles: a lead jeep, the foreman's jeep, and a portal bus. When the group encountered smoke in the track entry, they experienced two vehicle wrecks, one of which actually knocked the construction foreman and another miner off their vehicle. In the wreck, the miner lost his hard hat and cap lamp and had to escape without them. This became a problem, since the miner was continually hitting his head against the mine roof on the way out. In addition, this miner pulled the SCSR that he was about to don out of its carrying case. The SCSR could not be reattached to the case, resulting in the device having no carrying straps. To help this miner carry the device, another miner used electrical tape to fasten the SCSR to his buddy's chest. Since SCSRs tend to get very warm with use, the miner also had to contend with this discomfort.

During the escape, the construction foreman remained aware of the condition of others in the group and responded to a miner who was having trouble with his SCSR. When the construction foreman said to put on the SCSRs, a wireman said:

> I was like shakin' like a leaf, couldn't get the damn thing open. And he finally come up to this control and said, "Here, pop this, stick this in your mouth."

It is of interest to note that, whereas in some of the other groups there was a "second lieutenant," in this group the construction foreman was totally in charge:

> I was a foreman in charge of that area, and when I said to these people what we had to do, there was no second-guessing my decision. These people were counting on my knowledge that this was right and there was no second-guessing it. I had no problem with these people as far as my decision...I didn't ask for information or input from anybody else. That was my decision that we were gonna take this course to get out.

The foreman was authoritarian, but did not act as a dictator; he told the group the what and why of his decisions. He remarked:

> I think that once they knew where they were, the direction that they headed, where they were going to come out at and get into a fresh air area, it kinda eased their minds as to knowing. Basically, they knew how long it would take to walk to these different locations and they knew that there would be communications to the surface at these locations. And it pretty much eased their minds.

Leadership of the group was decisive, informed, logical, and confident. All group members safely evacuated the mine.

8 Face Parallels - Cokedale

This group was not normally a working group, and none of the members were involved in coal production. Members of the group typically performed maintenance or support tasks and were doing construction work and moving supplies in the section at the time of the fire. In addition, there happened to be two motormen in the section delivering rails when notified of the fire. Normally, these individuals worked on their own across many areas of the mine.

This group was effectively out of control most of the time during their escape. The foreman, the authority figure, was not in control, and there was considerable notation of blame and emotion evidenced in the interviews of this group. The manner in which the group donned their SCSRs was indicative of the lack of leadership. When asked who decided it was time to put them on, a mechanic responded, "Well, I think everybody decided together but, you know, I already had mine on." Another miner said he kept asking, "Should we put these on?" and the foreman never answered. The regular authority figure, the foreman, proved to be a poor leader. As a mechanic described:

> The guys were more or less talking amongst themselves, and I said, "You know, this is real serious and this boss if we're not careful he's going to get us killed."

A trackman with the group was not familiar with the section and became concerned:

> I can understand how people could be excited and you know, improper decisions could be made. But, you know, it kept snowballing. You know, his improper decisions that he was making, you know. I was getting more and more negative about following this man as we went... I'm not saying that I was the only person that was cognizant that [the boss] didn't know what he was doing. I believe everybody had some, you know, at some level had that feeling. But the fear level was starting to rise.

A mechanic remarked:

> There was a lot of confusion...the [foreman] couldn't figure out how to get into the intake escapeway...a lot of the guys started getting kind of real, losing a lot of confidence in him.

A leader who fit the profile characteristics did emerge: he was knowledgeable and discerning, his leadership evolved, and he was responsive to others in the group. The miner who emerged as leader began in the "second lieutenant" position as an advisor. He "knew" based on an odor that there was something wrong. There was an odor and some smoke and he said to another miner, "Turn that machine off, there is something bad wrong here." This miner was acutely aware and noted numerous details while continually processing information. He could "hear that the power center was on," and that confused him.

A general inside laborer (GIL) at the time of the fire, this miner was a former maintenance foreman and knew that the power center should not be on. He was one of the first to recognize the gravity of the situation while the rest of the group were speculating what was on fire. The GIL knew by the amount of smoke that the fire was not just a trolley wire hanger burning. He recognized that the men were getting upset, and as he explained:

> I am a personal friend of [the foreman] and...the situation, I wanted to talk to [him] but I did not want other people to hear what I wanted to tell him because people were getting upset right off the get-go...I was thinkin' of people I can count on...I guess you would say that it was kind of a feeling of if you were in an airplane and you had to count on someone to hold that parachute for you could you count on that person.

During the group's escape, this miner was continually evaluating the situation. A further example of this was when he discussed his concern that the men were struggling:

> If these guys start droppin', there is no way we, the three of us can pick up three other guys and carry them and get through these old workings, there's no way. So then I'm thinking well the next steps we're gonna have to start barricading ourself, that's all.

The GIL told the interviewer that when the group was in the returns in heavy smoke, he was looking for footprints. He knew that the returns had to be walked periodically by the fire bosses who examine the area for hazards. The GIL said:

> When I see footprints I feel better...Somebody was through here already, there is only one set going out. So chances are that if there was a return set of footprints, I would think somebody had to turn around because it's blocked.

This route, in fact, led the group to safety.

The leader of this group was conscious of the behavior of other members and careful in how he presented his advice to them. When some members of the group left their lunch buckets behind, he was concerned.

> How can I say it? Being a foreman for 8 years, it's hard not to say things sometime...I could see things going on that was wrong, especially the discarding [of the buckets]. So I would say, "I sure wouldn't throw that away." I wouldn't say, "Don't throw that away, you don't know how long we're going to be here or what's going to happen."

The statement above characterized this general inside laborer who had once been a foreman. He presented himself as the foreman's helper during his interview, whereas the other members of the group clearly indicated their foreman was inept and that the GIL led them out. He placed himself in a peer relationship with the group and a peer relationship with the foreman. In his interview, the foreman quoted the GIL often and was resplendent with the sentiment: "I should have." At one point the foreman stated, "I plain freely admit, I screwed up."

Discussion

A comparison of the three mine sites revealed no evidence of differences among the sites that would be relevant to this study. There were no appreciable

disparities in communication, emergency systems, firefighting response, safety issues, or subject demographics. Leadership in the eight groups thus will be compared across mines without bias.

Among the persons who led each of the eight groups to safety, five of the group leaders were the regular person in charge (usually the foreman) and three individuals emerged as leaders during the groups' escapes. As described previously, analysis revealed consensus characteristics which, taken together, create a leader profile. The individuals who assumed positions of leadership during the underground mine fires fit a profile that included the following characteristics:

- Aware, knowledgeable
- Decisive, yet flexible
- Open to input from others
- Calming influence; gained followers' confidence
- Logical decision-makers
- Allowed leadership to develop naturally

The reasons that leaders emerged other than the regular authority varied in each of the three groups. In the case of the group from 1 Right at Adelaide, it was the foreman's first night on the job. He maintained his authority in the group but was recognized as incapable of leading because he was not familiar with the mine. For the group from 3 Left at Adelaide, there was a split escape and no clear leader emerged. The third emergent leader, found in the group that escaped from 8 Face Parallels at Cokedale, took over when the hierarchal leader panicked and was ineffective in making decisions.

In examining the instances where there was a lack of leadership from the authority figures, two characteristics emerged. First, a lack of knowledge contributed to an individual's inability to guide his group. Second, leaders "lost personal control" and thus heightened anxiety in their groups. As shown in the group from 1 Right, a lack of knowledge did not necessarily result in a loss of authority. A lack of self-control, however, was more likely to have such an outcome. This seems true even though no evidence of actual panic behavior was found in any of the authority figures or leaders.

Throughout this analysis, support was found for the affiliation model of emergency response, as opposed to the panic model. Although there was evidence of "nonsocial, blind, irrational behavior" as defined by Hodgkinson [1990], the study reported in this chapter found that the majority of subjects behaved appropriately and within the accepted social framework. In fact, the social structure was defended, in several instances beyond reasonable evidence to the contrary, an example of which can be seen with the group from 8 Face Parallels. In this group, the members initially continued to turn to the foreman

even after he had shown his indecision and evidenced his inability to lead the escape.

The present study supports previous research in concluding that panic is reduced by introducing appropriate leadership [Misumi and Sako 1982]. Effective leadership also increased the likelihood of efficient evacuation. As found in earlier research [Hodgkinson 1990; Sime 1983; Abe 1976], the miners tended to head for a familiar route and/or follow the route others were using. In all cases, the group's first direction of travel and mode of transportation chosen were those used in routine trips out of the mine. Numerous times throughout the interviews, miners mentioned following the person ahead when the familiar route became impassable. When a knowledgeable person was in the lead and the followers had confidence in that person, the evacuation proceeded more smoothly.

Future Research

Are characteristics identified in the profile presented *required* for an individual to fulfill the role of leader during a crisis situation? What if an individual has some, but not all of the noted characteristics? Some individuals identified during this study evidenced several, but not all, of the profile characteristics. Further analyses are needed to determine the fit of these individuals in the group dynamics and their contributions to the successful escapes. Another realm of crisis behavior only mentioned in this study is the influence of leader/follower familiarity on the ability to lead. Is personal relationship in crisis leadership a component of success or failure? Affiliation theory suggests that familiarity influences behavior. However, analyses were not completed to document relationships between leaders and followers prior to their escapes.

This work supports Hayashi's [1988] emphasis on the study of the anticipated behavior patterns of leaders as complementary to the study of the circumstances of disaster escape. Training for response to mine emergencies, and therefore to other emergency situations as well, should consider the likely human behavior tendencies. Perhaps work crews should be evaluated to ensure that at least one person can and would lead the group in the event of an emergency. These potential leaders may, or may not, be the authority figure who leads during routine production.

This research suggests that the quality of leadership shown during these mine evacuations affected the responses of victims and the efficiency of their escapes. Furthermore, a profile was developed based on the actions and words of the most successful leaders. Perhaps these findings can be generalized to other emergency situations. If so, it may be helpful to share the profile with individuals who could be in positions of authority during a worksite emergency.

The profile could be used as a guide for training in leadership development. Another important finding of this work is the need for explicit communication about all facts known during an emergency. In these fires, increased knowledge of the danger allowed better planning for evacuation and for more decisive actions to be taken. Even in very dangerous situations, knowledge of the problem did not cause miners to panic and act irrationally; instead they continued to think and act based on all the information available. It is therefore suggested that training be given to all miners to promote effective leadership and to reinforce the importance of detailed communication during mine emergencies.

References

Abe K [1976]. The behavior of survivors and victims in a Japanese nightclub fire: a descriptive research note. Mass Emergencies *1*:119-124.

Bardo JW [1978]. Organizational response to disaster: a typology of adaptation and change. Mass Emergencies *3*(2/3):87-104.

Canter D, ed. [1990]. Fires and human behavior. London, U.K.: David Fulton Publishers, p. 3.

Driskell JE, Salas E [1991]. Group decision-making under stress. J Appl Psychol *76*(3):473-478.

Hayashi O [1988]. A simulation study of leaders behavior in a fire [Translation]. Tokyo, Japan: Tokyo Institute, Department of Psychology.

Hodgkinson P [1990]. Ways of working with panic. Fire Prev *June*(23):35-38.

Holsti OR [1990]. Crisis management. In: Gald B, ed. Psychological dimensions of war. Newbury Park, CA: Sage Publications, Inc., pp. 116-142.

Johnston DM, Johnson NR [1988]. Role extension in disaster: employee behavior at the Beverly Hills supper club fire. Sociolog Focus *22*(1):39-51.

Misumi J, Sako H [1982]. An experimental study of the effect of leadership behavior on followers' behavior of following after the leader in a simulated emergency situation. Japanese J Exp Social Psychol *22*:49-59.

Morris BG [1991]. Perceptions of leadership traits: comparison of adolescent and adult school leaders. Psycholog Reports *69*:723-727.

Sime JD [1983]. Affiliative behavior during escape to building exits. J Environ Psychol *3*: 21-41.

Smyth JW [1985]. An educative empowering notion of leadership. Educational Management and Administration.

Sugiman T, Misumi J [1984]. Action research on evacuation method in emergent situations II: effects of leader/evacuee ratio on efficiency of follow-direction method and follow-me method. Japanese J Exp Social Psychol *23*(2):107-115.

Sugiman T, Misumi J [1988]. Development of a new evacuation method for emergencies: control of collective behavior by emergent small groups. J Appl Psychol *73*(1):3-10.