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Modifying Supervisory Practices to Improve Subunit Safety: A Leadership-Based Intervention Model

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This article presents a leadership-based intervention model designed to modify supervisory monitoring and rewarding of subordinates' safety performance. Line supervisors received weekly feedback based on repeated episodic interviews with subordinates concerning the cumulative frequency of their safety-oriented interactions. This information identified the priority of safety over competing goals such as speed or schedules. Section managers received the same information and used it to communicate (high) safety priority. They also were trained to conduct episodic interviews to provide intermittent feedback after intervention, turning safety priority into an explicit performance goal. Safety-oriented interaction increased significantly in the experimental groups but remained unchanged in the control groups. This change in safety-oriented interaction was accompanied by significant (and stable) changes in minor-injury rate, earplug use, and safety climate scores during the postintervention period.

Maintenance of safe behavior is a managerial challenge because of the inherent bias against safe conduct in seemingly harmless job conditions. Contrary to the assumption that self-preservation overrides other motives (Maslow, 1970), safety studies have indicated that careless behavior prevails during job activities for which risk is unjustifiably played down. Failure to use the protective gear provided at the workplace accounts for approximately 40% of work accidents, and this statistic has not changed for more than 20 years despite continuing efforts (National Safety Council, 1996). A cost–benefits analysis suggests that safety precautions often entail a modest but immediate cost in terms of slower pace, extra effort, or personal discomfort. If the likelihood of injury is underestimated (a result of underestimation of rare events), the expected utility of unsafe behavior exceeds that of safe behavior. The attractiveness of unsafe behavior is reinforced by the tendency to assign short-term results greater weight when one is choosing among action alternatives (Herrnstein, Loewnstein, Prelec, & Vaughan, 1993). Thus, safe behavior poses a managerial challenge.

Most successful intervention programs have tried to modify the value function for safe behavior by introducing short-term rewards that outweigh immediate costs. Literature reviews reveal that most interventions have used the operant perspective of role behavior and the attendant ABC framework (i.e., antecedents–behavior–consequences; see Luthans & Kreitner, 1985; Stajkovic & Luthans, 1997). Furthermore, they have used two kinds of antecedents—namely, training and goal setting—and two kinds of consequences—namely, feedback and incentive. Consistent with the operant perspective (Skinner, 1974), antecedents have rarely been used except in combination with positive consequences of some kind (Geller, 1996; Krispin & Hantula, 1996; McAfee & Winn, 1989; O'Hara, Johnson, & Beehr, 1985). For example, Lingard and Rowlinson (1997) launched their intervention on construction sites with a series of joint (workers and supervisors) goal-setting meetings, leading to specific performance safety goals concerning housekeeping activities, access to heights, and scaffolding construction. These meetings were followed by publicly displayed feedback charts for 8 weeks, based on observations conducted by trained observers. During that time, the gap between the baseline level and the designated goals had to be minimized, providing the necessary incentive for change. A meta-analysis by Krispin and Hantula revealed strong effect sizes for most interventions, confirming the efficacy of this approach. At the same time, because most interventions have incorporated no other variables, the authors of this meta-analysis suggested that it is time to move on and expand the theoretical framework of behavioral safety research by including constructs and variables from other domains of organizational behavior and safety research.

One relevant construct is group leadership, or supervision. Effective line supervisors continually provide the antecedents and consequences mentioned above. A series of field studies conducted by Komaki and colleagues (see review in Komaki, 1998) revealed two primary attributes of effective supervision: performance-based monitoring and timely communication of consequences. Effective supervisors monitor work in progress, particularly through work sampling (i.e., direct observation), and act accordingly. This practice clarifies both supervisory directives and expectations (i.e., antecedents) and behavior–outcome contingencies. Thus, whereas conventional behavior modification interventions depend on external observers and other appointed officials (including coworkers) to provide feedback and deliver incentives, effective supervisors obtain the same information and deliver incentives as part of their daily routine. For example, an effective supervisor would

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observe whether work on a difficult task is performed properly, including the use of protective gear, and express approval or disapproval immediately thereafter. Although it is possible for external intervention to continue indefinitely, it is probably more susceptible to interruption than effective supervisory practices. Furthermore, safety becomes the responsibility of line supervisors rather than safety personnel or appointed coworkers, who cannot monitor the work as effectively as supervisors can. An intervention that improves supervisory safety practices could offer, therefore, a new intervention model in which a distinctive feature is that intervention takes place at the level above target behavior; that is, supervisory practice is modified to introduce change on the shop floor. This is a cross-level change whereby processes taking place at one hierarchical level influence a lower subordinate level (Klein, Dansereau, & Hall, 1994; Morgeson & Hofmann, 1999).

Facet-Free Versus Facet-Specific Leadership Perspectives

One important attribute of behavior safety is that it is often at odds with other performance aspects, particularly speed and productivity (Fahlbruch & Wilpert, 1999; Pate-Cornell, 1990; Wright, 1986). As noted above, doing things in a safe manner often entails a slower pace, extra effort, or less convenience. Consequently, whenever work pressure increases, a supervisor sets relative priorities for safety versus speed or productivity, depending on factors such as personal beliefs and sent expectations from immediate superiors (Zohar, in press). Because work pressure (i.e., role overload) is the most common stressor for white-collar and blue-collar occupations (French, Caplan, & Harrison, 1982; Quick, Quick, Nelson, & Hurrell, 1997), it follows that safety may often conflict with other performance aspects. Given prioritization, some aspects will be monitored more closely and followed by stronger consequences. This conflict suggests that improved supervisory monitoring and rewarding may not necessarily improve behavior safety. In other words, in conflicts between safety and speed, supervisory effectiveness will influence subordinates' safety only if safety is given high priority.

This analysis suggests a distinction between facet-free and facet-specific perspectives for (transactional) leadership. A *facet-free* perspective implies that effective supervisors regularly monitor all aspects of subordinates' performance, obtain first-hand information, and provide timely and contingent responses (Komaki, 1998). Such a model, however, is not viable in situations in which there is conflict between task facets and priorities must be set. In this case, a *facet-specific* perspective is more appropriate, in that effective supervisors more closely monitor certain performance aspects and adjust the consequences depending on the relative priorities. Facet-free and facet-specific leadership perspectives are complementary, referring to different levels of analysis. The facet-free perspective refers to global, job-level attributes of effective supervision (i.e., across situations and outcome criteria), whereas the facet-specific perspective refers to task-level attributes. I suggest that the facet-specific perspective is more appropriate for behavioral safety because it takes into account factors such as competing task facets (i.e., level of analysis should correspond with level of theory; see House, Rousseau, & Thomas-Hunt, 1995; Klein et al., 1994).

A recent study demonstrated that the relationship between transactional leadership and safety records depends on the relative priority of safety (Zohar, in press). The study demonstrated that better transactional leadership scores were associated with better safety records in subunits in which safety had been assigned high priority by immediate superiors (i.e., section managers) and with worse records when safety priority had been relatively low. At the same time, ineffective supervision was associated with poor safety records regardless of safety priority. In other words, supervisors monitored and rewarded certain performance aspects, depending on assigned priorities. Subordinates in respective subunits must have put greater emphasis on those aspects of performance being better monitored, resulting in a moderated relationship between supervisory practice and safety records. In 1990, Pate-Cornell noted that workers on offshore oil platforms were willing to take life-threatening risks to meet production targets considered to be top priority, providing an extreme example of facet-specific leadership. I suggest that maintenance of behavior safety during routine job operations benefits from effective supervision, provided it is coupled with high safety priority.

The present study was designed to test the effect of improved (facet-specific) supervision on safety records in organizational subunits. Improved safety supervision was achieved by providing weekly personal feedback concerning relative frequencies of safety-related monitoring and rewarding interactions with subordinates. To maintain the expected improvement, higher level superiors were trained to collect information concerning supervisory safety monitoring, using the same techniques as those used during intervention. This training should have reinforced supervisory safety practices, also providing continuing emphasis on safety. Given that subordinates are expected to put greater emphasis on those aspects of performance being better monitored, supervisory safety practices should influence the likelihood of injury, that is, better safety records. Based on these premises, the following hypothesis was formulated:

> *Hypothesis 1:* Improved supervisory safety practices will result in better subunit safety records.

In addition to collecting information concerning supervisory safety practices as well as safety records in work groups, safety climate perceptions were also obtained to examine relevant cognitive changes induced by intervention. This was done to ascertain that modified supervisory practices influenced employees' appraisal of the relative priority of safety (i.e., safety climate). As noted above, such change should mediate the relationship between supervisory practice and safety records. I used a recently developed group-level climate scale (Zohar, 2000) for which the factorial structure fits the facet-specific perspective; that is, it refers specifically to supervisory expectations of and reactions to safe–unsafe behavior under ordinary and high-pressure conditions. The interpretation of climate as collective assessment of relative priorities (i.e., safety vs. production) follows the theoretical model presented by Zohar (2000). It is acknowledged, though, that other definitions of safety climate abound (Guldenmund, 2000). On the basis of the above discussion, the following hypothesis was formulated:

> *Hypothesis 2:* Improved supervisory safety practices will result in higher safety climate in organizational subunits.

As noted above, this study used safety records (i.e., injuries) in organizational subunits as the main outcome variable. Two factors influenced this decision. First, collecting performance safety data as well as supervisory practice data would have required twice as many (or twice as long) observation visits to each subunit, and participating managers considered this activity too obtrusive. Second, safety records were derived from medically treated minor injuries judged as clearly resulting from unsafe behavior (see the description of microaccidents in the *Measures* section). Given the added feature that experimental and control groups had been matched in terms of risk levels, these records constituted objective indicators of performance safety in organizational subunits. It is important to note that microaccidents, as defined above, are due to any unsafe act, so that the cumulative frequency of such accidents provides an objective estimate of the overall rate of unsafe behavior in organizational subunits. These data compare favorably with the common practice of using few target behaviors to assess intervention effectiveness (e.g., Lingard & Rowlinson, 1997). The effect of modified supervisory practice on one particular unsafe behavior—namely, use of earplugs—was also tested. This test was not originally planned and began only in the 3rd week of intervention in response to a request by a senior manager. Use of earplugs was easy to monitor because the earplugs used in that company were conspicuous and because they were necessary only at a limited number of workstations. Thus, this monitoring of earplug use could be performed during originally scheduled visits. Unlike other personal protective equipment, earplug use could not have influenced injury data, thus providing an independent outcome measure. Hence, the last hypothesis was as follows:

> *Hypothesis 3:* Improved supervisory safety practices will result in higher rates of earplug use in organizational subunits.

Method

Subjects and Procedure

The participants in this study were 381 line workers and 36 supervisors in a regional maintenance center specializing in repair and upgrading of heavy-duty equipment. Because large materials were often handled, the work was done away from stationary workstations, which is known to increase hazard levels at the workplace. The workforce was all male, with the average age being 38.7 years (SD = 8.1 years) and the average plant tenure being 6.6 years (SD = 5.9 years). The all-male supervisory personnel were older (average age = 44.9 years, SD = 7.1 years) and more tenured (average tenure = 13.6 years, SD = 8.2 years). The workforce was divided into 36 work groups, 18 of which served as the experimental group and 18 of which served as the control group. Work groups were first matched in terms of job characteristics and risk levels and then assigned (quasi) randomly to experimental conditions. Matching on both parameters was performed by the company's industrial engineer, who was also responsible for in-house safety audits. Matching criteria included relevant risk factors assessed in safety audits, such as heavy materials handling, hazardous chemicals, and uneven or slippery work areas. Assignment to experimental conditions was constrained by organizational structure so that supervisors reporting to the same superior were included in the same condition. During the 3-month period prior to the experiment, baseline rates of safety-oriented supervisory interactions and minor injuries clearly resulting from unsafe behavior (identified here as microaccidents) were established, and safety climate questionnaires were administered. These questionnaires were completed anonymously during work hours 1 month before the intervention. The same procedure was used during the 3-month period after the intervention. Another brief check of supervisory interactions was conducted 5 months after the intervention.

The intervention phase lasted 8 weeks, during which feedback was given weekly to supervisors and their immediate superiors (i.e., section managers). It consisted of cumulative frequencies of reported episodes between supervisors and their subordinates in which safety was the criterion for supervisory approval or disapproval (identified as safety-oriented episodes) out of all reported role-related episodes in a given work group during consecutive 1-week intervals. Supervisors received individual feedback, whereas section managers were given comparative information about all of the supervisors in their section. This information was collected by means of indirect behavior sampling methodology as follows: Members of the research team visited each work group twice weekly, using a quasi-random schedule of time and day of arrival. (Random selection was limited by rules such as avoiding visits immediately before or after lunch or on the 1st day of the week.) On each visit, a prearranged counterbalanced sampling, using an imaginary grid, determined which worker would be approached. In an average group of 10 workers, 3–4 workers were interviewed on each visit. A short semistructured interview was then conducted, using a backward recall procedure as follows: First, we asked for a brief "two-sentence description" of work performed over the past few hours, using natural time blocks (e.g., between breakfast and lunch). The worker was then asked to recall and briefly describe any role-related interaction he had had with his supervisor (including nonverbal interactions such as pointing a finger in approval or disapproval). The same procedure was then repeated for the previous time block and so on, until it was clear that the worker found it hard to recall previous activities. (It should be noted that work in this plant varied daily, meaning the work was characterized by low routinization.) Average span of recall covered the previous 2–3 days. The interviews initially took longer to complete, but after several repetitions, they averaged 3–5 min. Workers were assured of anonymity, considering that only summarized statistics were used. The plant's paramedic (who also served as safety officer) informally monitored both workers' trust in this procedure and possible supervisory pressure. This monitoring was done during routine shop-floor visits, given his other role as safety officer (and by taking advantage of his sociability and personal acquaintance with most workers). He reported isolated instances of mistrust (mostly at the beginning) and no relevant supervisory pressure. The same interviews were conducted for experimental and control groups, except that the control-group supervisors were not given weekly feedback.

Section managers involved in the experiment were instructed to inform subunit supervisors of their relative position and to communicate approval or disapproval depending on this information. Because the intervention was only of limited duration, section managers emphasized from the outset that modified supervisory practice would afterward become mandatory. One week before concluding, a half-day workshop with participating section managers and the general manager of the plant was conducted. They were shown how to conduct (occasional) role-episode interviews with workers and how to cumulate information for intermittent feedback for supervisors. Role-playing exercises covered both role-episode interviews and social reinforcement skills. Although I had intended to use a switching replication design (i.e., to include the control group in the intervention program 6 months later), this idea was discarded because unscheduled downsizing about 5 months after the intervention resulted in layoffs and reorganization of the entire workforce.

Measures

Safety-oriented supervisory role episodes. Safety-oriented supervisory role episodes were measured with repeated interviews of subordinates as described above. Episodes reported by workers were cross-validated on a double-blind basis by asking their respective supervisors to describe work-related interactions with subordinates during the same time periods, using the same backward recall procedure. Overlap across the entire measurement period averaged 76%. Episodes reported by workers were classified as safety-oriented, production-oriented, or both. Thus, episodes in which a supervisor referred to the pace or quality of completed work, expressing satisfaction or dissatisfaction or merely commenting on it, were classified as production-oriented, whereas references to proper actions with safety implications or reminders relating to relevant safety rules were classified as safety-oriented. (It should be noted that workers were asked to report only work-related interactions.) Classification reliability was tested by agreement of two independent judges familiar with the work on-site. Results revealed considerable agreement (r_s = .84, $p < .01$). Feedback to supervisors consisted of the cumulative number (percentage) of safety-oriented episodes out of all reported episodes over consecutive 1-week periods. Episodes relating to both safety and production issues were counted as both (i.e., were included in the numerator and the denominator).

Microaccidents. Microaccidents were recorded by the three medical staff members of the infirmary on the premises, under primary responsibility of a paramedic who also served as safety officer (and was a 20-year veteran in this plant). The term *microaccidents* is used to denote minor injuries that met the following criteria: injury incurred due to unsafe behavior (i.e., incompatible with prescribed operating procedures), suffered during work activities, and of sufficient severity to discount the possibility of an unjustified visit to the infirmary. Intermittent reliability checks, involving discussion with "safety-loyal" employees (i.e., shop-floor employees responsible for safety monitoring), resulted in nearly complete agreement with infirmary records. One threat to the reliability of the injury data is possible underreporting due to supervisory or peer pressure against infirmary visits, especially in the experimental groups. To assess this bias, I computed the ratio between justified and unjustified infirmary visits, based on injury severity. The resulting ratios were 0.19 for the experimental group and 0.16 for the control group, suggesting there was no difference between experimental conditions in this regard. Microaccident rate was computed as the cumulative number of subunit injuries over each 3-month period, divided by group size. Injury distribution over time was tested and found to resemble a uniform, nonskewed distribution.

Earplug use. Earplug use was measured twice weekly just before starting the episodic interviews in each work group. Observations were limited to the noisy areas (i.e., >85 dB) where there were graphic signs requiring ear protection. Earplugs supplied by the company were conspicuous, looking much like colored Walkman headsets. Rate of earplug use was computed by the cumulative number of workers using them, divided by the total number of workers in the noisy areas at the time of observation. Because of the dynamic nature of work in this plant, most workers were not required to wear earplugs all day. It should be recalled that recording this behavior began only in the 3rd week of intervention, resulting in missing baseline data.

Group safety climate. Group safety climate was measured with a 10-item questionnaire consisting of two subscales: supervisory action and expectation (Zohar, 2000). Examples of action items are "My supervisor says a good word whenever he sees a job done according to the safety rules" and "My supervisor seriously considers any worker's suggestion for improving safety." Examples of expectation items include "As long as there is no accident, my supervisor doesn't care how the work is done" (reverse scored) and "Whenever pressure builds up, my supervisor wants us to work faster, rather than by the rules" (reverse scored). Alpha reliabilities for preintervention administration were .71 for the action subscale and .77 for the expectation subscale. Postintervention alpha reliabilities were .74 for the action subscale and .75 for the expectation subscale.

Results

Paired t tests were first performed on unaggregated data to confirm uniformity between experimental and control conditions prior to the intervention. Differences on climate subscales and microaccidents were not significant. Homogeneity of climate perceptions was then assessed with the r_{wg} statistic (James, Demaree, & Wolf, 1993). Glick (1985) provided a heuristic for this coefficient whereby values of .70 and above warrant aggregation of individual responses. Assuming uniform null distribution, climate subscales yielded no median r_{wg} coefficients exceeding critical values (i.e., .57 for safety action and .59 for safety expectation). Consequently, climate perceptions were treated as individual-level variables akin to psychological climate (Jones & James, 1979), rather than as group-level variables as originally intended (Zohar, 2000).

Cumulative frequencies of safety-oriented role episodes for the experimental and control groups are presented in Figure 1. A sharp increase in frequency of safety-oriented episodes for the experimental groups can be seen, rising from a base rate of 9% to a plateau averaging 58%. At the same time, there was no noticeable difference for the control groups. It is important that there was no decline up to 5 months after the intervention, indicating an endur-

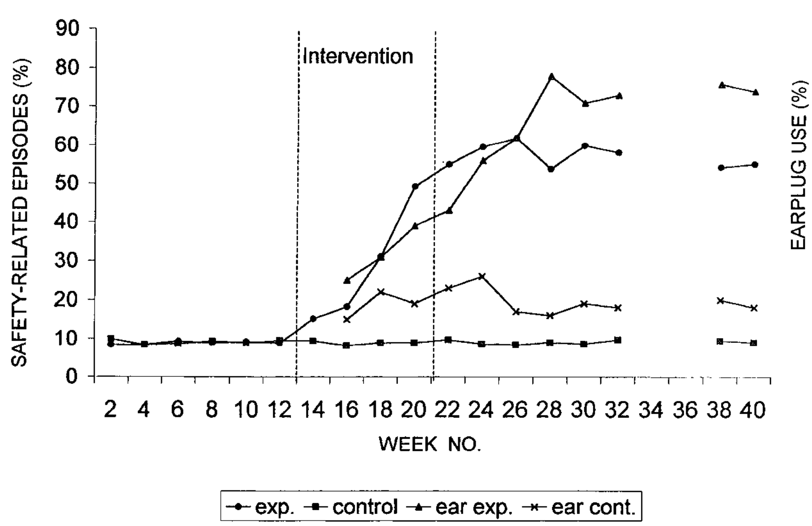

Figure 1. Interrupted time-series data of supervisory safety practices and earplug use. exp. = experimental group; cont. = control group.

Table 1
Repeated Measures Analysis of Variance for Microaccident Rate (Group-Level Analysis)

Source	$F(1, 33)$	p
Between (Experimental vs. control group)	9.61	.001
Within (Before vs. after intervention)	0.08	*ns*
Between × Within	16.40	.001

ing change in supervisory safety practices. By the end of that period, habit strength could have been reached, resulting in new supervisory behavior patterns. Frequency of earplug use, also presented in Figure 1, showed a similar pattern—a sharp increase from an initial 25% in the experimental groups (apparently influenced by the intervention) to a plateau averaging 73%. At the same time, there was no change for the control groups, averaging 18%. As before, this level was still maintained 5 months after the intervention. This finding is consistent with Hypothesis 3 concerning the effect of supervisory safety practices on unsafe behavior in organizational subunits.

The effect of the intervention on microaccident rate was tested with a repeated measures analysis of variance model. Because microaccident rate was a group-level variable, work groups were the units of analysis. Results are presented in Table 1. As shown, there was a significant interaction between intervention phase (i.e., before or after the intervention) and experimental condition, $F(1, 33) = 16.40$, $p < .001$. Examination of the shape of the interaction (see Figure 2) reveals a significant decrease in injuries for the experimental groups during the postintervention period, $F(17) = 16.57$, $p < .001$, accompanied by a significant increase for the control groups during the same period, $F(17) = 6.24$, $p < .05$. The latter finding may have resulted from changes in the physical layout of the plant during that time. These changes probably disrupted habitual behavior, thereby increasing the likelihood of error (Reason, 1990). Lack of increased supervisory safety monitoring in the control groups may have temporarily increased microaccident rates, whereas increased safety monitoring in the experimental groups countered the elevated risk. Overall, therefore, the results support Hypothesis 1 concerning the effect of supervisory safety practices on safety records in organizational subunits.

The effect of intervention on safety climate perceptions was tested with a repeated measures analysis of variance model. Results of this analysis are presented in Table 2. Homogeneity of climate perceptions in this sample did not justify group-level aggregation, so the statistical model used 364 degrees of freedom. As shown in Table 2, both climate subscales exhibited significant interactions between intervention phase and experimental condition: For the action subscale, $F(1, 364) = 6.81$, $p < .01$, and for the expectation subscale, $F(1, 364) = 3.56$, $p < .05$. Figures 3A and 3B indicate that this interaction was due to the fact that whereas climate scores increased in the experimental groups, the same did not apply to the control groups. This result is consistent with Hypothesis 2. As presented in Figure 3, climate expectation scores exhibited greater change than action scores as a result of intervention, $F(187) = 6.70$, $p < .01$.

Discussion

This study was designed to test a leadership-based intervention model that uses ongoing interaction between supervisors and subordinates to modify reinforcement contingencies for safe behavior. It derives from the concept that modifying facet-specific supervisory practices will induce concomitant change on the shop floor. The intervention consisted of providing weekly personal feedback concerning frequency of safety-related interactions with subordinates, together with communication of (high) safety priority from direct superiors (i.e., section managers). Results indicate that supervisory safety practices (i.e., frequency of safety-oriented interaction with subordinates) changed over a short period from a baseline rate of 9% to a new plateau averaging 58%. This change, in turn, resulted in a significant decrease in microaccident rate and a parallel increase in use of earplugs for the experimental groups, accompanied by a significant improvement in their safety climate perceptions. Results for the control groups remained unchanged. Because microaccident rate is influenced by all kinds of unsafe behavior, including transient or uncommon action, it can be concluded that the intervention had an overall effect on performance safety.

Leader-based intervention offers several advantages. It makes use of ongoing interaction between supervisors and subordinates instead of relying on extraneous parties to communicate antecedents and consequences. When a supervisory practice becomes habitual, turning into a new managerial norm, it should be less susceptible to interruption. This practice should also result in role change whereby safety becomes the responsibility of line supervisors rather than safety personnel. At the same time, being facet-specific, it will also depend on relative priorities communicated by higher level management (as well as supervisory discretion). In addition, it presents a marked contrast with available intervention

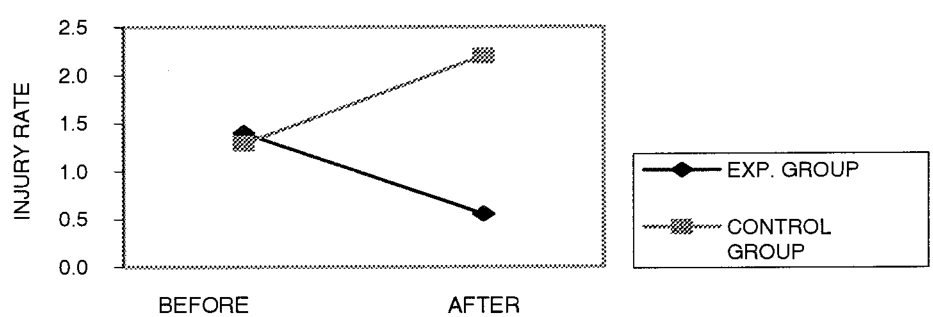

Figure 2. Interaction between experimental (EXP.) condition and treatment phase (microaccident rate).

Table 2
Repeated Measures Analysis of Variance for Climate Subscales (Individual-Level Analysis)

Source	$F(1, 364)$	p
Action subscale		
Between (Experimental vs. control group)	2.20	*ns*
Within (Before vs. after intervention)	1.90	*ns*
Between × Within	6.81	.01
Expectation subscale		
Between (Experimental vs. control group)	1.51	*ns*
Within (Before vs. after intervention)	0.10	*ns*
Between × Within	3.56	.05

programs, which are designed to modify discrete, often simple target behaviors that can be easily observed for feedback purposes (Krispin & Hantula, 1996; O'Hara et al., 1985). A leader-based intervention allows modification of all subordinate safety behaviors (including transient and uncommon ones), because antecedents and consequences are based on continual supervisory monitoring in ever-changing situations. Leader-based intervention can also be advantageous economically. In an average group of 10 employees, modifying the behavior of 1 key individual is conducive to improving a wide range of behaviors in those whom he or she supervises. Thus, a relatively small group of individuals can induce plantwide change.

From a theoretical standpoint, this intervention model is advantageous because it creates a link with an important construct of management theory, namely, leadership. After more than 20 years of behavioral safety research, the time has come to attempt better integration with other domains of management research. The present case, incorporating leadership with behavior safety, offers one possibility in this direction. Inclusion of more than one performance facet in the intervention model (e.g., safety and speed) will expand this line of research, though it would require more complex, yet clear and consistent rules concerning relative priorities. Such an intervention should improve supervisory effectiveness in high-pressure situations, which are especially prone to accidents. Furthermore, it should reduce role conflicts (French, Caplan, & Harrison, 1982) in situations requiring employees to emphasize both safety and speed although each comes at the expense of the other (as when superiors try to protect themselves in the eventuality of an accident).

Another line of research implicated by this study relates to the distinction between transactional and transformational leadership (Bass, 1985, 1990; Yukl, 1998). Whereas the present study dealt with transactional supervision, several recent studies have suggested that transformational leadership is associated with better

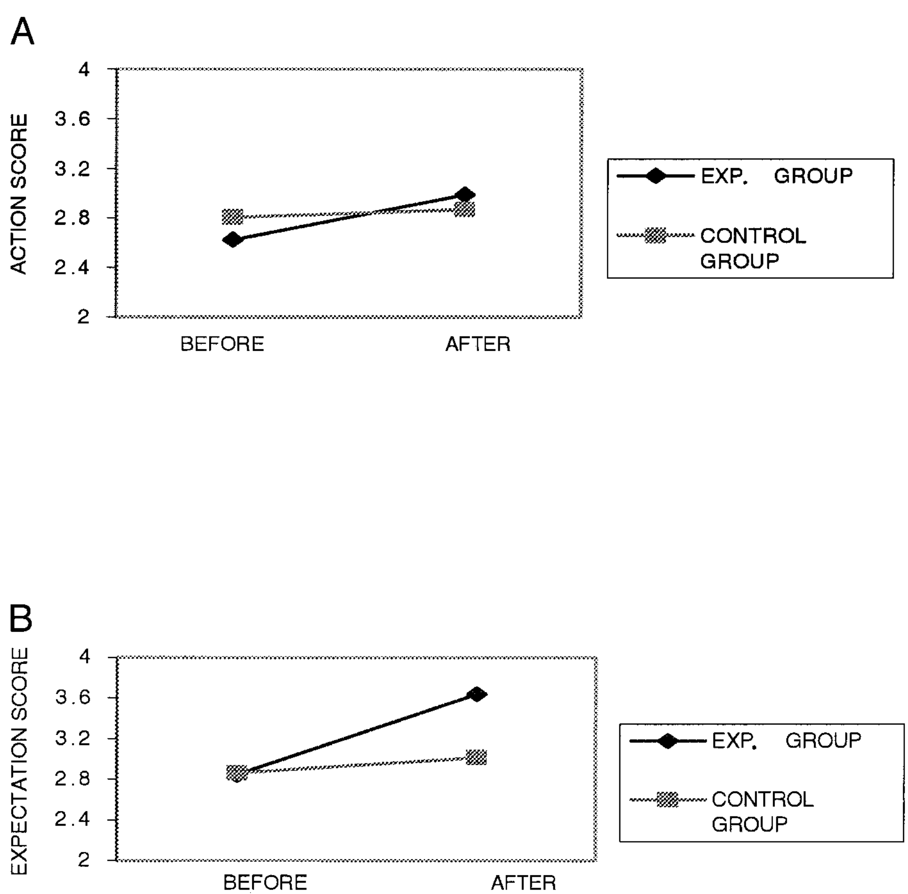

Figure 3. Interaction between experimental (EXP.) condition and treatment phase for (A) the climate action subscale and (B) the climate expectation subscale.

safety records (O'Dea & Flin, 2000; Williams, Turner, & Parker, 2000; Zohar, in press). This effect of transformational leadership can be attributed to, among other things, greater concern for members' welfare (Bass, 1990; Yukl, 1998), including physical welfare in situations involving heightened risk of injury (Hofmann & Morgeson, 1999; Zohar, in press). Overall, therefore, it can be argued that whereas improved transactional supervision enhances performance reliability of shop-floor employees, transformational qualities should result in incremental effects, especially under high production pressures. This augmentation implies that leadership-based intervention should be expanded to include both leadership factors. Another possible expansion, albeit of a different kind, is suggested by a recent study showing that leader effectiveness (measured in terms of leader–member exchanges, or LMX scores) influenced subunit safety records through its effect on openness of safety communications (Hofmann & Morgeson, 1999). Considering that the LMX model refers to leadership at the dyadic level of analysis (Dansereau, Yammarino, & Markham, 1995), this framework implies that leadership-based intervention should also be tested at the dyadic level. These ideas jointly suggest rich opportunities for research.

This intervention model also offers a general method for (transactional) leadership development. As noted by Cacioppe (1998), leadership development programs should include multiple training methodologies. Available methods are typically classroom-based (i.e., away from work), using information derived from various sources, for example, leadership and personality scales, 360° feedback, and simulations with group observations (Gist & McDonald-Mann, 2000). The episodic interviews provide complementary, work-related information, offering an additional training method for leadership development. This method is particularly relevant given research suggesting that supervisors are often reluctant to provide (negative) feedback to poor performers (Moss & Martinko, 1998), otherwise known as the "mum effect," pertaining to general reluctance to deliver criticism or bad news (Lee, 1993). The data presented above suggest that this bias can be overcome, resulting in improved supervisory practices.

Another theoretical implication of this research concerns the cognitive role of climate perceptions. Since its inception, safety climate research has been based on the assumption that climate perceptions serve the adaptive function of informing behavior–outcome expectancies (Zohar, 1980). In other words, they inform subordinates of organizationally sanctioned ways of performing a job, allowing them to anticipate supervisory approval or disapproval in a variety of situations, especially when prior information is not available. The present study is an empirical test of this interpretation, because it manipulated those supervisory attributes to which safety climate perceptions are said to relate. The fact that climate perceptions improved significantly under experimental conditions provides empirical support for this idea. However, it should be noted that the data structure in this study did not allow for testing the relationship between supervisory practice (i.e., percentage of safety-oriented episodes) and climate scores, because the former was a group-level variable and the latter an individual-level variable (i.e., climate variables failed to meet homogeneity criteria). The relationships between such cognitive and behavioral constructs should be explored.

A related issue of interest to safety climate research is the fact that climate perceptions in this sample were not homogeneous, as anticipated. Examination of the number of episodes reported by each interviewed individual revealed a skewed distribution, indicating that some workers reported more episodes than others in the same group. This finding may reflect individual differences in episodic memory, but it may also suggest true within-group differences in frequency of supervisor interaction with individual subordinates. The latter premise is reinforced by the high degree of overlap between workers' and supervisors' reports, using a double-blind procedure. Within-group differences might be due to individual-level factors such as safety rule evasion and job-level factors such as inherent technological risk, which would prompt supervisors to approach some subordinates more often than others. Climate perceptions will be affected by such differences, resulting in lack of consensus, that is, psychological rather than collective climate (Brown & Leigh, 1996). This possibility can be best investigated from the perspective of LMX relationships (Graen & Uhl-Bien, 1995), as suggested above. Because previous research using the same questionnaire (Zohar, 2000) reported homogeneous climate perceptions, the need arises to identify conditions under which subordinate perceptions do (or do not) converge.

To summarize, the present research suggests that the hierarchical nature of organizations allows for behavioral safety interventions at the supervisory level, namely, above the shop-floor level where injuries occur. This cross-level effect implies that complementary interventions can be conducted concurrently at several hierarchical levels. Given that occupational safety, as measured by workers' compensation rates, has hardly improved over the past 20 years despite sustained efforts (Shannon, Mayr, & Haines, 1997), it seems that new intervention models are needed. I hope that the model presented in this article and the possibility of complementary, multilevel interventions will stimulate further research along these lines.

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