APPENDIX A

TRAINING INTERVENTION STUDIES AS FOUND IN THE LITERATURE ADDRESSING VARIOUS TYPES OF OCCUPATIONAL HAZARDS

A-I. Safety/Injury Hazard Control

A-II. Control of Health Hazards—Chemical Agents

A-III. Control of Health Hazards—Physical Agents

A-IV. Control of Ergonomic Hazards

A-V. Control of Health Hazards—Biologic Agents

APPENDIX B

EXTRACTS FROM BUREAU OF LABOR STATISTICS (BLS) WORK INJURY REPORTS FOR DISCERNING REAL/POSSIBLE GAPS IN JOB SAFETY/HEALTH TRAINING

APPENDIX A

TRAINING INTERVENTION STUDIES AS FOUND IN THE LITERATURE ADDRESSING VARIOUS TYPES OF OCCUPATIONAL HAZARDS

A-I. Safety/Injury Hazard Control

Work Setting Operation (Ref)	Training Objective	Training Plan	Evaluation Method	Extra-Training Factors	Results	Comments
744 nurses attending 27 wards in 973-bed mental hospital subject to risk of inpatient assault. (Carmel & Hunter, 1990)	To train staff in techniques for defusing or otherwise controlling potentially violent acts by patients to limit the risk of injury.	Staff required to take 16 hours of instruction, as part of initial training plus 6-8 hours refresher training, every 2 years in managing assaultive behavior. While not detailed in the report, other sources indicate the training stresses verbal techniques for defusing potentially violent behavior and non-offensive physical ways to control or restrain violent acts by patients.	Data accessed from 1986 enabled authors to relate staff injuries from inpatient assaults to nurse compliance with training, and to wards serviced by staff showing a high versus low compliance with training.	None elaborated.	The rate of staff injury from patient violence in the wards with low training compliance in managing assaultive behavior (20/100 staff) was almost 3× the rate of those in the high compliance wards (7/100 staff). For nurses not having the training, 18.2% reported assault-type injuries as compared with 11% for those nurses who had the instruction. Similar comparisons for nurse CPR training did not show association with ward or nurse injury incidence; hence, the effect was content specific.	Although suggestive, authors admit that the association between training and reduced assault injury outcomes cannot be treated as cause and effect.

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58 male workers engaged in machine, boiler, and welding shop tasks in a plant manufacturing heat exchangers. (Chhoker & Wallin, 1984)	To promote worker conformance to 35 behaviors deemed critical to safe work performance.	A list of 35 critical behaviors was formed based on analyzing 5 years of accident reports, observing of plant operations, and National Safety Council (NSC) recommendations. Over a 6-week period, slides were shown contrasting safe work acts versus unsafe ones. A goal was established and posted for attaining 95% safe behavior.	After 5 weeks, workers were given a safety quiz in which workers were asked to differentiate slides of safe versus unsafe acts. In addition, a checklist of the 35 behaviors was used by independent observers to rate compliance of the workers 1–2 times per week before, during, and at various stages of post-training where feedback was given to the workers.	Following the training phase, feedback of safety performance as observed/rated on the checklist was posted and compared to the goal. This was done first on an every week basis and then every 2 weeks.	Percent (%) safe performance scores for the various phases of the study were as follows: o Baseline = 65% o Training/Goal Setting = 81% o Training/Goal Setting/Feedback (1 per week) = 95% o Training/Goal Setting/Feedback (l per 2 weeks) = 97% o Training/Goal Setting/Feedback withdrawn = 89% o Training/Goal Setting/Feedback reintroduced (1 per 2 weeks) = 94%	Results suggest the potency of feedback in reinforcing safe behaviors and their durability. Goal setting by itself has positive but lesser effects on safe performance. Training, goal setting, feedback as a package create optimum performance.

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96 operators of industrial lift trucks at two warehouse sites. (Cohen & Jensen, 1984)	To promote operator awareness and adoption of 14 specific actions critical to safer operator/vehicle use.	Focus was on 14 worker behaviors that could be observed, measured, and related to accident occurrences as defined by a task-hazard analysis. 5 training sessions (20-45 minutes long) were given on 5 successive days: 1 introductory, 3 instructional, and 1 practice/exercise. Slides were used to show incorrect/correct behaviors; Practice session had group grade performance of each trainee on a practice run.	3 observers counted frequencies of the correct/incorrect 14 behaviors as noted at 8 locations at each warehouse on a daily basis. At Warehouse 1, operators were divided into 3 groups: training only, training + feedback, and a control group that was trained only after 1st post-training evaluation. Study plan had monthly pre-training and post-training 1 & 2 phases, plus a retention phase that was 3 months after post-training 2. At Warehouse 2, all workers trained at same time and all received feedback.	All levels of management had input into the program and supported its development. Feedback supplied daily through verbal and posted summaries of group performance. All groups subject to training set an 80% goal attainment level.	For Warehouse 1, at end of retention phase and after all workers trained, overall decrease in incorrect acts was 44%. Training + feedback group showed best scores in post-training 1. At Warehouse 2, overall improvement in 14 behaviors was 70%. 12 of 14 target behaviors indicated clear improvements; 2 were resisted because they involved an uncomfortable posture, and exposure to exhaust fumes.	The effect of training to achieve safer work behaviors is clear. Question: Will it reduce accident/injury rate in lift truck operations?

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500 soda-ash miners at 2 sites and 450 lead-zinc miners at 2 sites (Fiedler, Bell Jr., Chemers, & Patrick, 1984; also Fiedler, 1987)	To compare two approaches to management training. One involved organization development (OD), i.e., team-building and problem-solving; the other, a pre-packaged supervisory standard program (SP). Both aimed at improving productivity and safety performance.	OD approach stressed interactions at all management levels down to first-line supervisors and workers. Priority problems discussed and solutions developed for implementation. Four 45-minute meetings with miners held for their inputs. SP approach used 2 modules: one (6–8 hours) teaches leaders how best to exercise control fitting their own personality. The other, was in supervisory skills training (16 hours) to handle problems at an individual level. Videotapes, role play were used throughout instruction.	OD approach employed in one lead-zinc mine whose lost-time accident rate, MSHA citations, and sick-absenteeism were compared with miners in a second lead-zinc mine for 2 years, before and 14 months after the program. For SP method, comparisons were made between soda-ash mines under study and those for total industry on the above measures plus productivity figures 1 year before and 2 years after the training. Evaluations for 3 added years were reported for the soda-ash mines using the SP training method.	OD mines endured a 9-week strike during the last year of the intervention, which confounded productivity measures. SP mines underwent market decline in use of product and management changes, but program apparently retained support.	For OD method, injury incidence rate fell 51% in mines during 2-year post-training period, and was lower than the comparison mine whose rate remained the same. Citations showed a steady decrease whereas comparison mine showed marked fluctuation. Absenteeism dropped from 11% to 7% after training. For the SP mines, the injury rate dropped from 14 to 6 per 200,000 hrs of work, which met the industry average. Production was 7%–12% greater than the industry average; citations fell 85% after training. Follow-up data at the SP mine for 3 added years found a further drop in accident rates (3–4 per 200,000 hrs of work), and decreases in MSHA citations (less than 50 per year as compared with 340 pre-intervention).	Authors note that both approaches proved effective, but that the OD is more costly to implement. Efforts to explain away other factors that could account for the results are mentioned, i.e., introduction of performance evaluation systems. Authors believe convergence of results is reassuring. Interviews with managers also hold view that training was effective factor in improving mine safety and productivity.

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Uranium miners at one site numbering from 197 to 606 over a 13-year period of data collection; from 450 to 501 coal miners at a second site over a 12-year period. Lost workdays from mining injuries at both sites exceeded the national average by factors of 3 or better. (Fox, Hopkins, & Anger, 1987)	To comply with MSHA regulations in providing safety and health orientation to new employees, formal job training in hazard recognition, use/maintenance of protective equipment, and knowledge of emergency procedures and first aid. Provisions for required refresher training were also in place.	Initial training for new employees included both classroom and on-the-job training with refresher training for others at yearly intervals. Retraining undertaken for those assigned to different jobs. Formal training carried out by a safety and health training staff. Bi-weekly "tool box" meetings held by foremen to discuss close calls and hazard conditions needing correction.	Compare frequency rate of mining injuries, numbers of days lost, costs of injury/damage events during a baseline period of 2–5 years versus a post-treatment period of 11–12 years. The treatment was to reward employees monthly with trading stamps for injury- or damage-free work, the stamp awards being greatest for those in the most hazardous jobs. Bonus stamps were given for useful safety suggestions, or when all workers under the same supervisor were w/o injury or damage claims.	The trading stamp reward program (described in the evaluation plan column) constituted an extra-training condition that was in effect for 12 years at the uranium mine site and 11 years at the coal mine site. Add-on training factors during this time span consisted of the refresher training, plus biweekly "tool box" meetings to discuss "close calls" or hazards needing attention.	Post-treatment results indicated substantial reductions in injury rates, days lost, and cost factors. Relative to the pre-treatment level, the frequency rate of injuries dropped by 85% at the uranium mine; and by 68% at the coal mine. Days lost were reduced by 89% at the uranium mine and 98% at the coal mine. Savings based on ratios of costs for injury/damage claims versus reward payouts varied from 18.1 to 27.8 at the uranium mine and from 12.9 to 20.7 at the coal mine.	Study shows how training may have been a necessary, but not a sufficient condition for the improvements to have occurred. Authors note that keeping the treatment in effect for 11–12 years offers an extended opportunity to examine efficacy issues.

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12 foremen working in a paper mill that employed 200 hourly workers and 30 manager/support personnel. Foremen responsible for completing and filing accident reports according to plant policy. (Fox & Sulzer-Azaroff, 1987)	To effect more effort by foremen to supply all requested information on accident investigation report forms.	Limited to a one-page memo instructing foremen on how to complete reports and announcing they would receive written feedback as to the thoroughness in filling out the form and other reactions as to the merit of the entries.	Compare number of items completed on plant accident report forms for the following periods: 3 months pre-memo instruction (baseline 1); 7 weeks post-memo when foremen received feedback on submissions (intervention 1); 6 months after feedback withdrawn (baseline 2); memo reintroduced with feedback for 5 months (intervention 2); feedback again withdrawn—reports analyzed for 1 year (follow-up).	Offered/withdrew feedback at different times following instruction. See also Comments column on observer effect.	Intervention periods 1 and 2 where feedback delivered significantly improved the completeness of reports; when withdrawn after 7 weeks (baseline 2) and after 5 months (during follow-up) this effect declined.	Gradual decline in completeness of reports reinforced by company's acceptance of incomplete forms. Results indicate need for feedback to sustain effort. During the follow-up period, the researcher was absent from the plant, which also could have helped to cue the desired response. The authors indicate need for alternative forms of feedback or other contingent reinforcers to support the desired behavior.

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38 bakery workers in two departments reporting excessive numbers of injuries. (Komaki, Barwick, & Scott, 1978)	To enable workers to discriminate between safe/unsafe work practices and conditions, and to identify and promote the adoption of safer work routines.	1/2-hour session using slides to depict safe/unsafe ways of performing job tasks within the two departments. Baseline data on frequency of safe job actions posted and workers set safe performance goal.	Checklists used for itemizing/scoring safe behaviors by independent observers. Scores taken before and after the instruction periodically for 20 weeks in one department and 12 weeks in the second.	Weekly feedback on safe performance given to workers for 11 weeks in one department and 3 weeks in another, after which it was withdrawn. Supervisors asked to recognize/log times workers engaged in select safe acts.	Frequencies of safe acts in the two departments rose dramatically after 1 week of feedback (from 70% to 95.8% in one and 77.6% to 99.3% in the other) and remained as long as feedback given. When feedback withdrawn, rates fell to earlier levels. Feedback reintroduced by management stabilized safe performance level. Coincident was a drop in lost time injuries from 35 to below 10 per million hours of work.	That the maintenance of safe acts were so dependent on feedback indicates continued need to prompt such behaviors. Raises questions about workers internalizing the idea of working safely.

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55 workers in 4 sections of the vehicle maintenance division of a city public works department showing one of the highest injury rates as compared with other divisions. (Komaki, Heinzman, & Lawson, 1980)	To effect changes in worker behavior with regards to proper equipment/tool use, wearing personal protective/safety equipment, improving housekeeping procedures, and other actions aimed at upgrading general safety performance.	Accident logs for past 5 years reviewed and weaknesses in current safety program used to frame behavioral targets specific to each of the 4 sections. After baseline observations directed to existent behaviors, workers attended session to view/discuss slides of unsafe acts and ways to prevent them, which became formulated into safety rules. Copies of these rules issued to workers.	Checklist of prescribed safety behaviors was used by trained observers who monitored workers' actions in each section 3–5 times per week. Study plan had 5 phases where these observations were taken to show the effects of training alone, training plus feedback, withdrawing and then reinstituting feedback as compared with baseline data. Total study span was 45 weeks; phases varied from 5 to 11 weeks.	Upon completion of training phase, supervisors of each section indicated goals to be met in complying with safety rules and observed and provided feedback on level of adherence through graphic displays. In subsequent phases, this graphic feedback was withdrawn and then reinstituted to define its effect in enhancing safe behaviors as prescribed in the original training.	Comparing % safe acts against the pre-training baseline data for the various phases showed the following gains: Training alone = 9%; Training + feedback = 26%; Feedback withdrawn = 17% (reduced the previous gain by 9%); Reinstituting feedback = 21% (regained 4% of the previous loss). During the 8-month period of the program, lost-time injuries dropped to 0.4 per month; before program the rate was 3.0/month; after program the rate was 1.8/month.	Results show feedback as important motivator in realizing benefits of worker training and increased worker knowledge. Authors comment that management gave verbal support to program but was inconsistent in actions such as attending safety sessions or recognizing persons for their program efforts. Frequency of feedback notices by supervisors also dropped off in the last phase, which could account for less than the full recovery of the earlier gain.

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Work Setting Operation (Ref)	Training Objective	Training Plan	Evaluation Method	Extra-Training Factors	Results	Comments
75 construction workers/managers who had completed coursework/seminars on occupational safety and health issues of consequence to construction work. (Lapping & Parsons, 1980)	To promote more and better effective safety and health protective measures in construction work, appreciate roles of labor, management, and OSHA in effecting such changes; improve reporting procedures; and identify need for further actions.	Workshops/seminars on construction health and safety were developed from and led by union craftmen/management graduates of two 3–4 week in-residence training programs with added fieldwork. Course content covered industrial hygiene, hazard analyses, communication/education techniques, cave-ins, fire protection, and OSHA laws re construction. 9 such programs conducted under the auspices of universities, building construcion trade council, operating engineers, etc. A total of 871 participants took the course.	Course recipients were polled by questionnaire as to the impact of the course. The report offers data from the first 75 respondees.	Added interviews with respondents to the questionnaire in three cities noted other activities that were prompted by the course or reinforced its value.	Of the first 75 respondents: 1) 77% noted that their OS&H activities had increased. 2) 93% noted increased OS&H measures on the job. 3) 96% indicated ability to furnish better protection. 4) 100% indicated increased competence. 5) 59% noted one component of course of marked value. 6) 92% noted better understanding of OSHA. 7) Up to 84% indicated that they personally had experienced an increase in work-related health and safety practices. 8) 99% appreciated need for management, labor, and OSHA to do more. 9) 36% noted novel management efforts to improve programs. 10) 18% were satisfied with enforcement.	Although positive, the data reflect subjective judgments and impressions; measures showing actual gains in construction safety/health outcome indicators remain to be seen.

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Work Setting Operation (Ref)	Training Objective	Training Plan	Evaluation Method	Extra-Training Factors	Results	Comments
100 college students serving as subjects in a study comparing different instructional methods for effective, safe operation of a punch press simulator. (Leslie, Jr. & Adams, 1973)	To test hypotheses about the merits of audio-tape/slides vs. videotape vs. face-to-face oral vs. no instruction in performing safe, precision work on a punch press simulator.	Subjects divided into 4 groups, 3 given instructions via one of three modes (slide/audio-tapes, videotape, and oral reading of written job information by trainee and demonstration by running one cycle of the press) in understanding the elements of punch press operations. The 4th group, a control, viewed 2 job cycles but otherwise lacked any training. Training was done in one session in all cases.	Following training, subjects operated a punch press simulator with sensors to detect injury producing actions/events (signaled by a loud klaxon horn) and defective quality parts in feeding 100 blanks into the machine. Measures taken included the number of accident events, number of proper parts alignment, elapsed time until first accident, total time to process 100 blanks through the press.	Not applicable.	The oral/demo method yielded the fewest accidents followed by the videotape, slide/audio, and no training conditions. Measures of elapsed time to 1st accident, total time to process the blanks, and the number of misaligned parts showed no significant differences between the training methods. Performance curves showed decrease in accidents for all groups but also an upturn near the end ot the performance trials suggestive of a fatigue or boredom effect.	Authors explain superiority of the classical method over the slide/audio and videotape in that it allowed the trainees to have a hands-on experience with the equipment. Still, learning curves for the videotape and slide/audio groups indicated a faster rate of learning than for the oral/demo method. Practical recommendations from study were 1) value of simulator in screening persons who pose high risks for such tasks, and 2) indications of boredom/fatigue points for repetitive work requiring interventions.

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1800 full- and part-time employees of a large community hospital (Lin & Cohen, 1983)	To establish a system of hazard detection, reporting, and problem-solving involving the workers, and to assess the merit of their participation in terms of improved safety/health indicators and/or reduced injury-illness cases.	Employees first completed forms on their perceptions of unsafe work conditions, risky job tasks, and suggested ways for correcting them as a learning experience in hazard recognition and control.Worker subgroup appointed to safety committee ensured these data and later hazard reports filed by workers were logged, reviewed by hospital safety staff and control actions taken where warranted. Human-factors specialist gave the subgroup of workers special training to aid them in promoting hazard detection efforts of the total workforce.	For a 12-month period before and after the intervention, comparisons were made of the hazards reported by workers, the concomitant number of incident staff injuries/illnesses, and the relationship between the nature of the hazardous conditions reported and the type of injury or illness.	Monthly reports of hazards noted, and actions taken in response were posted as part of the employee-based hazard reporting system in all hospital departments. Select hazard reports and remedial measures also included in hospital newsletters to sustain interest. The worker subcommittee also had a special publicity campaign on work safety/health midway during the post-intervention period to bolster interest.	Preintervention worker hazard reporting rate was 11 to 32 reports per month, the average being 23.5 per month. After system startup, rate was 24 to 48 per month, the average being 36 per month. Increased reporting was spurred by the special publicity campaign halfway in the 12-month evaluation period. Preintervention, injuries/illnesses numbered 32–33 per month; post-intervention rate showed a decline to 24 per month. Pre and post period differences in hazard reports and numbers of mishaps were statistically significant. Content of hazard report vs. actual injury cases showed agreement in some cases and not in others. Detection of hazards as physical, fixed, and environmental in nature predominated; less obvious were those having behavioral and/or procedural features.	In actuality, the results indicated a need for worker training to better appreciate operational or functional factors as well as physical ones in hazard detection. The overall program was successful to the point that the hospital continued to maintain it after the researchers who instituted it completed their work.

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Underground mining operations that present hazards of unsupported roof falls. 113 miners, attending retraining classes, served as a field test group in assessing training packages intended to make them avoid such areas. (Mallett, Vaught & Peters, 1992)	To instill fear in miners of going under unsupported roof locations in underground mines so that they would avoid such areas.	Three sets of training materials, each composed of a videotape and an instructor's guide. In videotapes, miners described involvement in real roof-fall incidents, and answered questions on dangers, impacts on selves, and on others. Class in small groups discussed these points, and ways to minimize risk. Field test conducted on two of three videotapes.	At session's end, questionnaire items rated on interest in session, new lessons learned, intent to stay within “inby” supports. Second questionnaire given 6 weeks later as part of safety talk. Items rated on recall of earlier session, talks with others about it, thoughts, and actions to limit exposure to unsupported roof locations in mines.	None elaborated.	First questionnaire ratings: 98% of miners believed tapes realistic; 75% noted new learning; 92% to show more care to avoid unsupported roof areas. Later questionnaire ratings: 75% thought about getting hurt in a roof fall, 95% noted more avoidance of such areas; half indicated they or buddies had changed their work habits as a result of being sensitized to the dangers.	Results based totally on self reports, which is a weakness. Whether one fear-producing training session can effect a behavior change seems dubious, especially since roof falls remain relatively rare events. Will added precautions as expressed give way under pressures to maintain or increase mine output?

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Work Setting Operation (Ref)	Training Objective	Training Plan	Evaluation Method	Extra-Training Factors	Results	Comments
Commercial fishermen who fish in Alaskan waters. This industry has the highest occupational fatality rate in the United States. (Perkins R., 1995)	To train captains and crew of Alaskan commercial fishing vessels in emergency preparedness, survival procedures, vessel stability and loading, and methods for conducting safety drills. Overall goal was to reduce the number of drowning deaths due to vessel mishaps in the Alaskan fishing fleet.	20-hour course offered by Alaska Marine Safety Education Association (AMSEA) stressing how to abandon ship, fight fires, use distress signals, make distress calls, launch survival craft, don survival suits, and recover people from water. Practice in using safety and survival equipment included.	To determine for the 4-year period 1991–1994 the number of graduates from the AMSEA course who were listed as fatalities or survivors in boat incidents occurring during the same period.	Mention made that practicing the emergency drills described in the AMSEA manual were important factors in saving the lives of crew members in two vessels not included in the study.	AMSEA drill instructor course graduates for 4-year period were 1518. None of 114 deaths from 159 reported boat incidents for the same period were AMSEA graduates. Among 227 identified survivors were 10 AMSEA graduates. 8 of 86 vessels with survivors but no deaths had one AMSEA trained person on board; none on board vessels reporting at least 1 death.	Results suggest that course is reducing fatalities among Alaskan crewmen. However, the numbers of graduates are only 3% of the total number of Alaskan fishermen; this raises the question of whether those who took the course were more safety conscious than the average fisherman. In other words, whether this attribute, more than the course, was responsible for the outcome.

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Two groups of 100 workers drawn from two departments engaged in aircraft maintenance work at a large facility employing 20,000 workers. The departments had comparable hazards and safety records. (Ray, Purswell, & Schlegel, 1990)	To identify and promote compliance with appropriate safe behaviors in performing pressure checks, hand rework, welding, and machining tasks.	Both worker groups given safety training focussed on use of protective clothing, removing inappropriate personal clothes or jewelry, safe materials handling practices, and machine operations. Elements of these actions were identified and included in a form used to define a safety performance index for use by observers in monitoring worker compliance. Training plan included one group setting goals for the safety performance index and receiving feedback on their progress. The second group received no such feedback.	Training leaders observed workers in both departments using the safety index form to rate safety performance. These observations were taken at random times during a 2-week period to establish baseline data for each group. Safety performance feedback was then given to one group whereas the second continued without such feedback for a 5-week period.	The feedback given to one group for 5 weeks consisted of posting charts, providing weekly updates of their safety performance, and weekly meetings to discuss continuing violations and ways to correct them.	For the feedback group, the safety performance index showed a continuous rise from a baseline of 84% to 100% at the end of the 5-week feedback period. The untreated group's index varied little (from 88% to 90%) over the total 7-week period of observations. Differences between the safety performance indices of the feedback vs. non-feedback groups were statistically significant.	Authors noted added positive side effects of feedback program in that 1) the work areas became tidier and 2) both the workers as well as their supervisors showed an increased awareness of safety issues at the workplace. The simplicity of the feedback treatment induced senior management to consider its adoption for improving safety throughout the facility.

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105 workers in 11 departments of a farm-equipment manufacturing plant who accounted for 95% of the company's accident reports. (Reber & Wallin, 1984)	To create increased worker awareness of specific safe work practices and set goals to achieve compliance with such acts.	Over a period of 10 weeks, daily 45-minute training sessions held discussing manual of safety rules plus slides shown of safe/unsafe acts. In later sessions, items in observational checklist of select safe-worker behaviors were explained with goals set to achieve them.	Departments divided into 3 groups: training only, training+goal setting, and training+goal setting+feedback according to a staggered schedule. Midway during training workers given a quiz to determine their knowledge of safe work practices. Behavioral checklist used post training to determine effects of goal setting and feedback on occurrences of safe acts. Injury rates for one department computed before and after the intervention.	In one post-training phase, supervisors gave weekly reminders to the workers of the safety goals established during the training session. In a second phase, goal setting was augmented by feedback, i.e., posting the observed safe behavior checklist scores 2 to 3 times per week.	The effects of training, goal setting, and posting feedback were each found to increase the frequency of observed safe behaviors. Adding feedback to goal setting provided the greatest increase in safety performance. Injury rates dropped from a pre-intervention level of 84.7 to 55.1 per year post intervention.	Design allows for separate effects of training, goal setting, and knowledge of results to be appreciated.

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104 undergraduate college students serving as subjects in an evaluation of the effectiveness of accident simulators as a means of teaching safe operation of power tools. (Rubinsky & Smith, 1971)	To demonstrate the feasibility of simulating grinder tool accidents and their usefulness as a training device. Bench grinder modified to simulate a disintegrating wheel accident by directing stream of water at the operator's normal position in front of the grinder. Training objective was to teach operators when starting up grinder (when risk of wheel explosion is most apparent) to stand to the side so as escape injury.	Two studies run where Ss divided into 4 groups as follows: G-1 = written instructions and demonstration of correct start-up procedure; G-2 = same as G-1 plus demonstration of simulated accident; G-3 = same as G-1 plus subject experiencing simulated grinder accident; G-4 = same as G-1 plus demonstration plus subject experience with simulated accident. Task for all subjects was to run spark tests on 10 steel rods to determine makeup.	Number of simulated accidents occurring to subjects in running spark tests on the 10 rods used to measure performance during training session and during a retention session 1 week later. In 2nd study, each group had a second retention test 4 weeks after the original training trial where standard pedestal grinder was used.	Not applicable.	In both studies, G-1 Ss had most "accidents" and G-4 the fewest. All groups having either demonstrated or experienced "accidents" (G-2, G-3, G-4) showed safer operation of the grinder in both the training and retention sessions. In 4 week retention trial, only G-4 (demonstration + experienced with accident) had significantly fewer "accidents" than other groups.	Study indicates the potency of simulated accidents as a training technique, especially under conditions where the operator experiences the simulated "accident." A follow-up study (Smith and Rubinsky, 1972) varied the frequency and method of presenting the simulated accidents during the training trials. Retention measured 6 months post-training found those with the accident simulations had fewer accidents than those with traditional safety instruction.

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A-I. Safety/Injury Hazard Control

Work Setting Operation (Ref)	Training Objective	Training Plan	Evaluation Method	Extra-Training Factors	Results	Comments
1136 shipyard workers organized into 13 departments. Small groups (4–13 workers/foremen) formed in each department were the focus of study in addressing housekeeping problems and how they could be controlled. (Saarela, 1990)	To identify and eliminate obstacles to good housekeeping, and establish new housekeeping practices in the various departments and for the personnel found therein.	Steering committee of top management plus safety staff provided information about program and main tasks with planning details, implementation left to department groups. Groups met to assess housekeeping problems in their own departments, developed remedies, held training seminars with all personnel to discuss goals for improved practices and set up a system to monitor results, which were posted.	Questionnaire surveys were used to gain reactions to the program's impact from group members and all department personnel at the end of 1 year. The program effect on accidents was determined on a before/after basis using yearly reports for cases of falls on the same or to a lower level, and of being struck by falling objects.	As noted in the overall program plan, all levels of the company organization had a function in the effort, which suggested a full commitment by top management on down.	More than half (53%) of the shipyard workers reported that housekeeping improved during the program. Departments varied greatly in this response: best was 92%; weakest was 28%. Changes in housekeeping most difficult for the largest departments (>100). Program year saw a 20% drop in relative number of accidents; this continued after the intervention.	Authors noted that groups used training, frequent measurement of the housekeeping level, and feedback to effect improved housekeeping practices in their department. Also stressed the participative feature in program success. Most active group in terms of meetings held and countermeasures taken reported the highest improvement score.

TRAINING INTERVENTION STUDIES AS FOUND IN THE LITERATURE ADDRESSING VARIOUS TYPES OF OCCUPATIONAL HAZARDS

A-I. Safety/Injury Hazard Control

Work Setting Operation (Ref)	Training Objective	Training Plan	Evaluation Method	Extra-Training Factors	Results	Comments
300 workers per ship engaged in equipping two tankers; and 650 workers per ship in equipping two car/passenger ferries.(Saarela, Saari, & Alltonen 1989).	To promote better housekeeping practices with emphasis on keeping cables/hoses out of pathways, more orderly workplaces, and proper trash disposal.	For tanker work crews, informational campaign with 35 slogans conveying specific safety instructions posted at sites for the required action. Slogans displayed 3 times for 2-week intervals, the display time being 10% of the tanker-equipping period of 7 months. 17 slogans used for ferries, 4–5 posted for 3–4 weeks; total display time was 40% of ferry-equipping period of 9 months. Inspections/ratings of housekeeping made and posted on bulletin boards to tanker crews; posted and written feedback given ferry crews.	Worker crews equipping one tanker and one ferry were exposed to the slogan campaign and compared with those equipping a second tanker and ferry who were not. Interviews used to determine extent of worker recall of slogans, typically at the end of a slogan display period. Average number and severity (days lost) of injuries compared between the tanker and ferry crews having the slogans with those not.	Safety personnel in the shipyard received all interview reports on the slogan recall; not clear whether they made changes in subsequent postings in light of these data.	Interviews with tanker crews found recall for 3–4 slogans of 35 (or 11%); for the ferry crew, recall was 1–2 of 4–5 presented per posting (or 32%). Comparisons of injuries/week and severity rates for tanker and ferry crews found the slogans to have no significant effect. If anything, the crews having the slogans showed a slightly greater rate of injury frequency and severity. Feedback had a small positive shift on housekeeping level for the tanker crew; little for the ferry crew.	Results suggest the limitation in media campaign for effecting behavior change. The feedback effect also proved only marginal.

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A-I. Safety/Injury Hazard Control

Work Setting Operation (Ref)	Training Objective	Training Plan	Evaluation Method	Extra-Training Factors	Results	Comments
32 workers in two production halls of a shipyard. (Saari & Nasanen, 1989)	To promote worker attention to and compliance with 9 housekeeping practices of consequence to both department safety and productivity based on foremens' suggestions, reviews of injury reports, and worker inputs.	1-hour training seminar given to workers, foremen, and production engineers focussed on the nine housekeeping targets. Pre-training (baseline data) observations on housekeeping problems shown and discussed.	Frequency of adherence to targeted housekeeping acts charted before, then at weekly, and then at 5- to 6-month intervals spanning a 3-year period. Injury reports before and after training reviewed to determine relation to any housekeeping improvement.	Feedback on compliance given to foremen for the first week post-training, then posted for all workers over a 6-month period. Compliance monitored for another 18 months in one hall and for 7 months in the second but with no feedback.	Compliance actions increased 29% in one hall; 22% in the second. Major changes occurred once feedback posted for all workers. Injury frequency fell by 75% during the 3-year post intervention period but improved housekeeping could only account for a 25% reduction.	Speculation that improved housekeeping leaves more capacity for noticing other potential hazards. Suggests that gains in housekeeping may facilitate other hazard control actions.
Five first-line supervisors of shipfitter crews showing excessive eye injury reports. (Smith, Anger, & Uslan, 1978)	To make supervisors more observant of worker use of protective eyewear and to reinforce increased use through praise and positive encouragement.	10 hours of instruction given supervisors in ways of observing, recording, and reinforcing worker use of protective eye glasses.	Before/after comparisons of dispensary reports of eye injuries for 5 crews whose supervisors received instruction versus others not subject to the intervention.	Supervisors of 5 crews responded with praise and encouragement to workers found to be wearing safety glasses in course of contacts at work stations.	4 of the 5 crews, after training of their supervisors showed a decrease in eye injury rate; the average decrease was 7.4 per 100 workers. This reduction made the rates of eye injuries comparable to those found for the other crews.	Data on actual use of safety glasses not reported. Later reassignment of supervisors posed problems in maintaining reinforcement of eyewear use.

TRAINING INTERVENTION STUDIES AS FOUND IN THE LITERATURE ADDRESSING VARIOUS TYPES OF OCCUPATIONAL HAZARDS

A-I. Safety/Injury Hazard Control

Work Setting Operation (Ref)	Training Objective	Training Plan	Evaluation Method	Extra-Training Factors	Results	Comments
225 employees in three departments of a large (total workforce=3,300) telecommunications manufacturer engaged in producing, assembling, and wrapping circuit boards and electrical components where the highest inury rates were reported. (Sulzer-Azaroff, Loafman, Merante, & Hlavcek, 1990)	To promote worker adherence to safe work practices, targeting specificactions and conditions that could reduce the frequency and cost of work-related injuries.	Review of injury records, interviews with staff, direct observations of defined "hot-spots", and high-risk behaviors for effecting change. Workers "told how to perform safely" in these situations with specific behavior targets noted. Supervisory team used to oversee program with successively higher goals set to meet targeted objectives with weekly feedback to workers on their progress. Token rewards given at meeting interim goal; luncheon when 100% reached and sustained.	Weekly tours of the 3 departments were used to rate safety achievement; these were joint observations of safe worker behaviors and zones free of hazards. Scores were collected for an 11-week baseline period, followed by 24 weeks where increased goals were set and progress plotted. OSHA- recordable injuries were noted for the three departments 6 months before and 6 months during the intervention along with program cost vs injury cost savings figures.	Upper level managers from the Vice President down were working under incentive plans to improve company safety, and department managers had previous experience in using performance management training. This organizational environment was ideal for the behavioral approach used in the study.	Safety achievement scores for the 3 departments at end of study were 92%, 99%, and 100% as compared with baseline values of 70–75%. Relative to figures 6 months before, OSHA- recordable injuries 6 months post-intervention showed reductions in the 2 higher scoring departments, but the third increased. All departments showed a decrease in lost-time cases. The latter resulted in an estimated savings to the company of $55,000.	Authors conclude that effecting improvements in safe work practices was responsible for the reduced injury rate. Although this may be true, the lack of any analyses to show how the observed injury reduction was dependent on the targeted safe behaviors tempers this conclusion.