JOURNAL OF APPLIED BEHAVIOR ANALYSIS 1987, 20, 215–224 NUMBER 3 (FALL 1987)

THE LONG-TERM EFFECTS OF A TOKEN ECONOMY ON SAFETY PERFORMANCE IN OPEN-PIT MINING

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A token economy that used trading stamps as tokens was instituted at two dangerous open-pit mines. Employees earned stamps for working without lost-time injuries, for being in work groups in which all other workers had no lost-time injuries, for not being involved in equipment-damaging accidents, for making adopted safety suggestions, and for unusual behavior which prevented an injury or accident. They lost stamp awards if they or other workers in their group were injured, caused equipment damage, or failed to report accidents or injuries. The stamps could be exchanged for a selection of thousands of items at redemption stores. Implementation of the token economy was followed by large reductions in the number of days lost from work because of injuries, the number of lost-time injuries, and the costs of accidents and injuries. The reductions in costs far exceeded the costs of operating the token economy. All improvements were maintained over several years.

DESCRIPTORS: safety, miners, token economy, long-term effects

Mining is a particularly hazardous occupation. In 1985, the most recent year for which data have been published for the United States, 500 people were killed in mining accidents and there were 40,000 work-related injuries that caused workers to miss 1 or more days of work (National Safety Council, 1986). The rate of lost-time injuries per person-hour worked in mining is almost twice as high as the rate in manufacturing and eight times as high as the rate in educational services (U.S. Department of Labor, 1984).

Most of the research on behavioral approaches to safety problems has focused on changing behaviors or behavior-produced environmental conditions assumed to be unsafe. For example, Rhoton (1980) decreased the number of federal government citations given a coal mine for violations of ventilation standards, and Geller, Johnson, and Pelton (1982) increased the rate of seat belt use. This research did not examine changes in the incidence or extent of injuries as the behavioral changes occurred. Therefore, the efficacy of the approaches was not determined.

A few reports of behavioral safety research have included measures of injuries or accidents to allow for the validation of the interventions. For example, Komaki, Barwick, and Scott (1978) used brief training and supervisor and graphic feedback to increase the percentage of instances in which bakery workers behaved in ways assumed to be safe. They reported that the lost-time injury frequency rate decreased to less than one-fifth the baseline rate within a year of the completion of their research. Fellner and Sulzer-Azaroff (1984) found that posting graphs of data about behaviors and work conditions changed both of these hypothesized con-

This research was supported solely by the companies immediately benefitting from it. Preparation of the manuscript was supported by the University of Kansas and the National Institute for Occupational Safety and Health. Mention of company or product names does not constitute endorsement by NIOSH, the University of Kansas, or the authors.

Special thanks are due to John T. Atkins and the late Jack E. Russell, mine managers, and to safety coordinator Bert Wisner.

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tributors to safety in a paper mill. Additional data substantiated that the behavioral changes were accompanied by a decrease in the rate of reported injuries. Van Houten et al. (1985) used feedback signs and warning tickets to reduce the speed of automobiles and found that there were correlated reductions in the rates of accidents and injuries.

All previous behavioral safety research has reported only relatively brief interventions. The Komaki et al. (1978) experiment observed the behaviors of the bakery workers for 3 to 11 weeks. The Fellner and Sulzer-Azaroff (1984) study included from 14 to 37 weeks, and the Van Houten et al. (1985) studies consisted of 5 and 6 months of data collection on accidents and injuries during treatment conditions. These are impressive beginnings, but the very effectiveness of the approaches emphasizes the importance of establishing long-term effects.

In the present study, we investigated the use of a token economy in which miners were given tokens for not having accidents or injuries for specified periods of time. Primary dependent variables were based on lost-time injuries. The interventions were maintained for several years, an unusually long period of time, and therefore provided an extended opportunity for examining efficacy.

The social importance of the safety problems was extreme at the mines in which the research was conducted. Before the token economy was instituted, the yearly average number of days lost from work due to on-the-job injuries at one of the mines was approximately eight times the national average for all mines, and the average at the second mine approximately three times the national average (U.S. Department of Labor, 1976). During the 5 years immediately preceding the beginning of the token economy, two people had been killed and a third person had suffered a permanent partial disability at the second mine.

METHOD

Settings

The research was conducted at two open-pit mines and their associated product processing facilities. One mine was located in the Shirley Basin area of Wyoming and was used to extract and mill uranium ore for the electricity-generating industry. The other mine was located in the Navajo area of Arizona and was used to extract and process coal used in generating electricity.

The two settings used similar mining procedures. Scrapers, large electrical shovels, draglines, and diesel-electric dump trucks were used to remove the overburden covering the ore-bearing veins. When the ore was reached, smaller shovels, bulldozers, scrapers, front loaders, and smaller dump trucks were used to load and haul the ore from the pit to the processing areas. The Shirley Basin pit was circular in shape, about 1.6 km in diameter and 122 m in depth. The Navajo site included three strip-type mines. The strip pits were rectangular in shape and approximately 200 m wide, 800 m long, and from 25 to 75 m deep.

Milling of the uranium ore consisted of crushing and ion-exchange processes to produce yellow cake, which was then trucked to other plants for enriching. The coal processing consisted of crushing, sizing, and washing operations. The resulting product was moved by conveyor to a nearby electricity-generating plant.

Injuries had occurred in all areas of both settings. However, the majority were associated with the use and maintenance of the heavy equipment.

Subjects

Subjects were the employees of the two mines. They included office and clerical personnel, engineers, management, custodial, maintenance, and production workers including the mining equipment operators and processing operators. The yearly average number of employees at the Shirley Basin mine was 197 at the beginning of data collection in 1970, increased gradually to 606 in 1979, then decreased to 214 in 1983 because of the declining value of commercial-grade uranium. The number of employees at the Navajo coal mine was 450 in 1970, gradually increased to 501 in 1982, and has remained at that level during subsequent years.

Baseline Conditions

Both mines were regulated by the Mining Safety and Health Administration (MSHA). In addition,

the directors of safety and health, the mine managers, the mine engineers, and the production managers developed safety and health policies for the mines. The MSHA regulations and company policies required safety and health orientation and training for new employees, ongoing refresher training for all employees, and frequent inspections and corrections of hazardous conditions.

Initial training for new employees included classroom and on-the-job training in hazard identification, correction, and avoidance; use and maintenance of personal protective equipment such as hard hats and respirators; emergency procedures; and first aid. Each employee was subsequently involved in at least yearly refresher training. Training in hazard identification, correction, and avoidance was provided all employees if they were reassigned to different jobs. The formal training was conducted by the safety and health staff. In addition, all mining, processing, and maintenance workers were involved in bi-weekly "tool box" safety meetings led by their foremen during work breaks lasting 30 to 60 min. During these meetings, common hazards and instances in which workers came close to having accidents were discussed, and workers brought hazardous conditions to the attention of the foremen who referred them to maintenance or to the mine engineer for correction.

Each week, the safety and health staff inspected all areas of the mines for correctable hazards and reported them to the mine manager and the head of the division responsible for them. In addition, health and safety staff stopped any work they observed that violated company safety policies until the violations were corrected.

Token Economy

Workers at both mines were divided into hazard groups according to the number of lost-time injuries reported during the baseline periods for people holding specific jobs. Workers in Group I included workers in the least hazardous jobs. All of these workers spent at least 75% of their work time in an office. Group II workers were foremen, shift supervisors, laboratory technicians, field engineers, surveyors, and their aides. Group III included mechanics, laborers, maintenance workers, and bulldozer, front-end loader, shovel, dragline, and truck operators. Group IV was made up of people in the most hazardous jobs. These workers were electricians, scraper operators, and fuel and lube workers.

The token economies were begun in 1972 at the Shirley Basin Mine and in 1975 at the Navajo Mine. Individual workers were given a specified number of trading stamps at the end of each month, accompanying their paychecks, if they had not suffered a lost-time injury or compensation injury that required a physician's care during the month. Initially, these individual awards at the Shirley Basin Mine were 300 stamps for workers in Group I, 400 stamps for those in Group II, 500 for Group III, and 700 for Group IV. Individual monthly awards at the Navajo Mine were: Group I, 400 stamps; Group II, 500 stamps; Group III, 600 stamps; and Group IV, 700 stamps.

In addition to the individual awards, at the end of each month all workers managed by a common supervisor were given an additional specified number of trading stamps if all workers under that supervisor had avoided lost-time or medically treated compensation injuries during the month. Initially, these group awards were 200 stamps for workers in Group I, 300 stamps for those in Group II, 500 stamps for those in Group III, and 700 stamps for those in Group IV at the Shirley Basin Mine. The initial group awards at the Navajo Mine were: Group I, 300 stamps; Group II, 400 stamps; Group III, 700 stamps; and Group IV, 800 stamps.

Safety awards committees made up of workers, supervisors, and safety department personnel also awarded to employees special payments of stamps ranging from a low of 500 stamps to a high of 25,000 based on safety suggestions that were adopted by the mine, acts that prevented serious injury or death to other workers, acts that prevented accidents and/or property damage to equipment, and any other special actions considered useful by the committee.

A worker who suffered a lost-time or medically treated compensation injury received no monthly individual stamp award or monthly group award for 1 month if he or she missed 1 or 2 days from work because of the injury, 2 months if 3 or 4 days were missed, 3 months if 5 or 6 days were

missed, 4 months if 7 or 8 days were missed, 5 months if 9 or 10 days were missed, and a maximum of 6 months if more than 10 days were missed.

The group awards based on the safety performance of all members of a group managed by a common supervisor were lost for 1 month if any worker in the group had a lost-time or medically treated injury. The workers were not again eligible for the group awards until the injured person returned to work.

Any employee immediately responsible for an accident resulting in damaged equipment lost the individual stamp award for 1 month for each $2,000 in damage costs up to a maximum of 6 months. All other workers in the same group with the person responsible for the equipment damage also lost their group awards for as many months as the individual lost the individual awards. Any worker who failed to report an accident or injury lost all stamp awards for a month. All other members of that worker's group also lost their group awards for that month.

Beginning in 1974 at the Shirley Basin Mine and in 1976 at the Navajo Mine, the number of stamps given in each of the above instances was increased each year proportionally to the number of stamps required to purchase specific items in the trading stamp redemption stores. This provided an adjustment in the awards that approximated changes in inflation.

Six weeks before the implementation of the token economies, workers were informed about the programs and the schedules of awards in the company newsletters. One month before the beginning of the token program at the Shirley Basin Mine, all workers who had not had an equipment-damaging accident or a lost-time injury in the previous 2 years were given 10,000 stamps. One month before the beginning of the Navajo program, all workers without a lost-time injury or an equipment damaging accident during the previous year were given 10,000 stamps.

Stamps could be exchanged at neighboring redemption stores that carried several hundred items of merchandise; many other items could be ordered from a catalog. In 1972, 3,000 stamps could be exchanged, for example, for a spice rack, 7,600 stamps for a comforter for a full-size bed, or 20,400 for a cast-aluminum, gas-fired barbecue grill.

No restrictions were placed on the workers' use of stamps and no systematic attempts were made to determine what they did with their stamps. Casual conversations suggested that workers and their families saved the stamps and exchanged them for a wide variety of items that included microwave ovens, cuckoo clocks, shotguns, bowling balls, and many kinds of small electric appliances.

Data Collection

MSHA regulations and company policies required that the mines keep extensive records of safety data. Four kinds of data were selected to represent most of what is important about safety at the mines. Two of these were traditional safety statistics, the number of job-related injuries that cause a worker to be absent from work 1 or more days and the total number of days absent from work because of injuries. Both of these measures are typically expressed in terms of a constant number (1,000,000 or 200,000) of person-hours worked to adjust for variations in employment and overtime. The first measure, Frequency Rate, is considered to be an index of the frequency of more important injuries, whereas the second measure, Severity Rate, is considered to be an index of the seriousness of injuries (American National Standards Institute, 1967).

In addition, direct costs of injuries and accidents are considered to reflect verifiable costs of accidents and injuries. In the present case, direct costs included those incurred for compensation insurance, medical care for injured workers, and repairing damaged equipment. These figures were proportioned to the yearly number of person-hours worked and adjusted for inflation by multiplying them by the implicit price deflators published by the U.S. Department of Commerce (1971–1986).

The costs of the trading stamps were kept as a part of the mines' purchasing records. A benefit-to-cost ratio was calculated to provide an index of the extent to which the dollars saved as a result of the token economy exceeded the costs of operating

the token economy. The cost of accidents and injuries each year, following the introduction of the token economy, was subtracted from the mean cost during baseline. This number was then divided by the costs of the trading stamps for that year. These data were also adjusted for inflation and hours worked as described above for the cost data.

Data collection did not involve reliability checks in the form typically conducted in applied behavior analysis research. However, numerous procedures safeguarded the reliability of the data. First, MSHA legally mandated that all mines keep data on the number of lost-time injuries and the number of days lost from work due to injury and was empowered to impose fines for violations of the mandate. The nursing offices at both mines kept data on the number of lost-time injuries and the number of days lost. The offices of the Directors of Safety and Health investigated all lost-time injuries and provided corroboration that the injuries had occurred. Supervisors and time-clock records verified absences from work. These data eventually were incorporated into payroll reports each month for worker verification. A copy of each accident and injury investigation was given to involved workers for verification.

Every Shirley Basin worker who suffered a medically treated injury, a lost-time injury, or an injury involving compensation individually filed a report with the Wyoming Division of Worker Compensation. The company independently filed a similar report for each injury. There was perfect agreement between the worker-filed and company-filed reports.

Both the Wyoming Bureau of Mines and the Mine Safety and Health Administration investigated every death, amputation, permanent disability, and temporary disability involving more than 90% loss of function. The agencies also randomly and without warning investigated a small but unknown percentage of medically treated and lost-time injuries. Reports of these investigations agreed perfectly with company records.

Compensation claims and lost-time injuries required independent verification by a physician. The costs of compensation insurance were determined by the states, based on records of a company's rate of compensable injuries.

The maintenance departments filed reports on each piece of equipment repaired, the labor costs of repair (based on the number of hours of labor required to carry out the repair), and the costs of replacement parts used in repair. All costs were eventually verified by independent bookkeeping checks conducted by external auditors.

Similar reporting, investigation, verification, and cost determination procedures were carried out at the Navajo Mine in conjunction with equivalent Arizona agencies.

Experimental Design

The token programs were begun at the mines according to a multiple baseline design (Baer, Wolf, & Risley, 1968). The program was begun at the Shirley Basin Mine in 1972 and at the Navajo Mine in 1975. However, the implementation of the token programs was not programmed according to considerations for demonstrating control. Rather, the senior author worked as Safety and Health Engineer at the Shirley Basin Mine and designed and installed the token program at that site in response to the serious safety problems at that mine. The management of the Navajo Mine elected to replicate the program because of the seriousness of their problems and the apparent successes produced by the program at the Shirley Basin Mine.

The token economies functioned as described above at the Shirley Basin Mine for 12 years until 1983, when mining ceased at the site because of the decrease in the demand for fuel-grade uranium. The program had been in use at the Navajo Mine for 11 years at the end of 1985 and is still being used.

RESULTS

The index of the severity of injuries, reflecting the number of days lost from work and proportioned to 1 million person-hours worked for each year for both mines, is plotted in Figure 1. At both mines, there were substantial decreases in number of days lost during the first years the token econ-

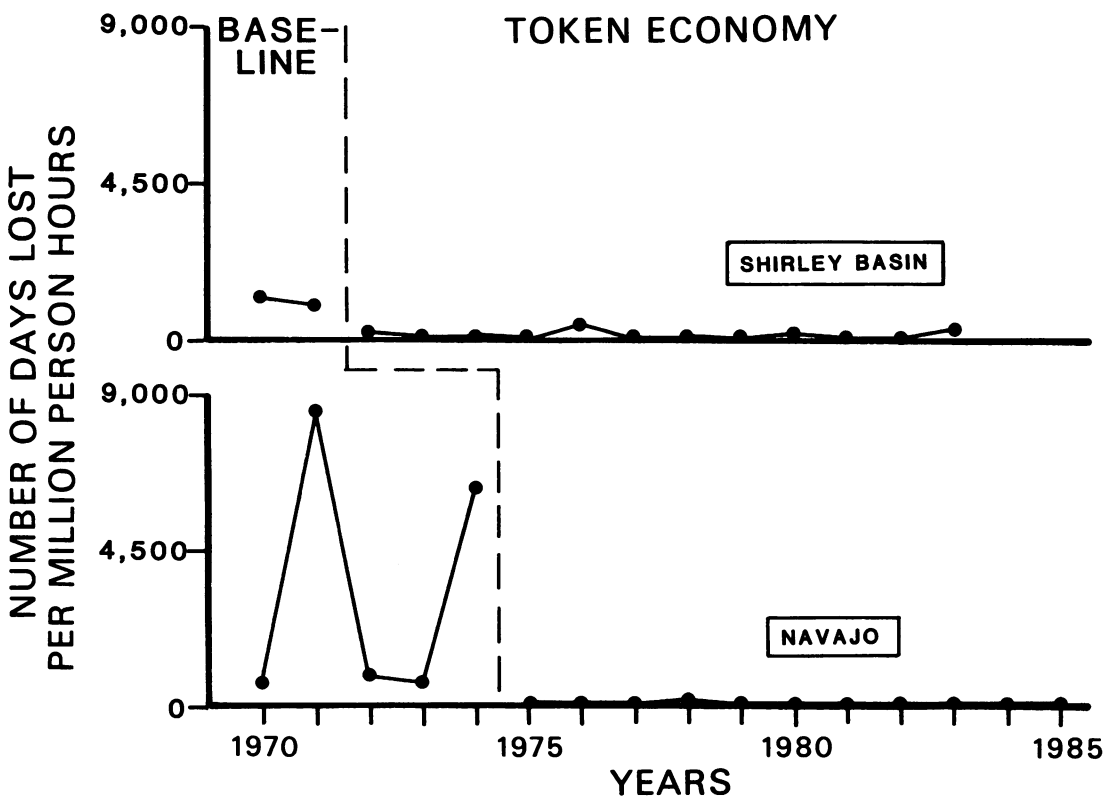

Figure 1. The yearly number of days lost from work, per million person hours worked, because of work-related injuries.

omies were in effect. The terminal level of this measure was about 11% of the average baseline level at the Shirley Basin Mine and about 2% of the baseline level at the Navajo Mine.

The number of lost-time injuries, proportioned to 1 million person-hours worked and plotted for each year for both mines, is shown in Figure 2. This measure ranged from 20 to 40 lost-time injuries per year during the baseline years in both mines. In the Shirley Basin Mine, during the first year following the introduction of the token economy, the rate of lost-time injuries continued a trend that was apparent during the baseline, whereas there was no appreciable decrease in rate in the Navajo Mine. However, by the end of the second year of the token economy these data had stabilized at a level that was only about 15% of the average baseline rates at the Shirley Basin Mine and about 32% of the average baseline rate at the Navajo Mine.

Costs of accidents and injuries, shown in Figure 3, declined at the Shirley Basin Mine from a baseline average of $294,000 per year to an average, during the years the token economy was in effect, of $29,000 per year in constant 1970 dollars. The decline in costs at the Navajo Mine was from a baseline average of $367,696 per year to an average, during the token economy, of $38,972 per year in constant dollars. Both declines approximated 90%.

The initial cost in 1972 of the stamps that were used in the token economy at Shirley Basin, including the stamps given to workers who had no lost-time injuries during the previous year, was $13,850 in 1970 dollars, and varied between $9,288 and $12,522 in constant dollars, over subsequent years. The first-year cost at the Navajo Mine was $21,940 in 1970 dollars, and varied between $11,359 and $13,415 in constant dollars, over subsequent years.

The benefit: cost ratios, or ratios of dollars saved by the reduction in costs of accidents and injuries

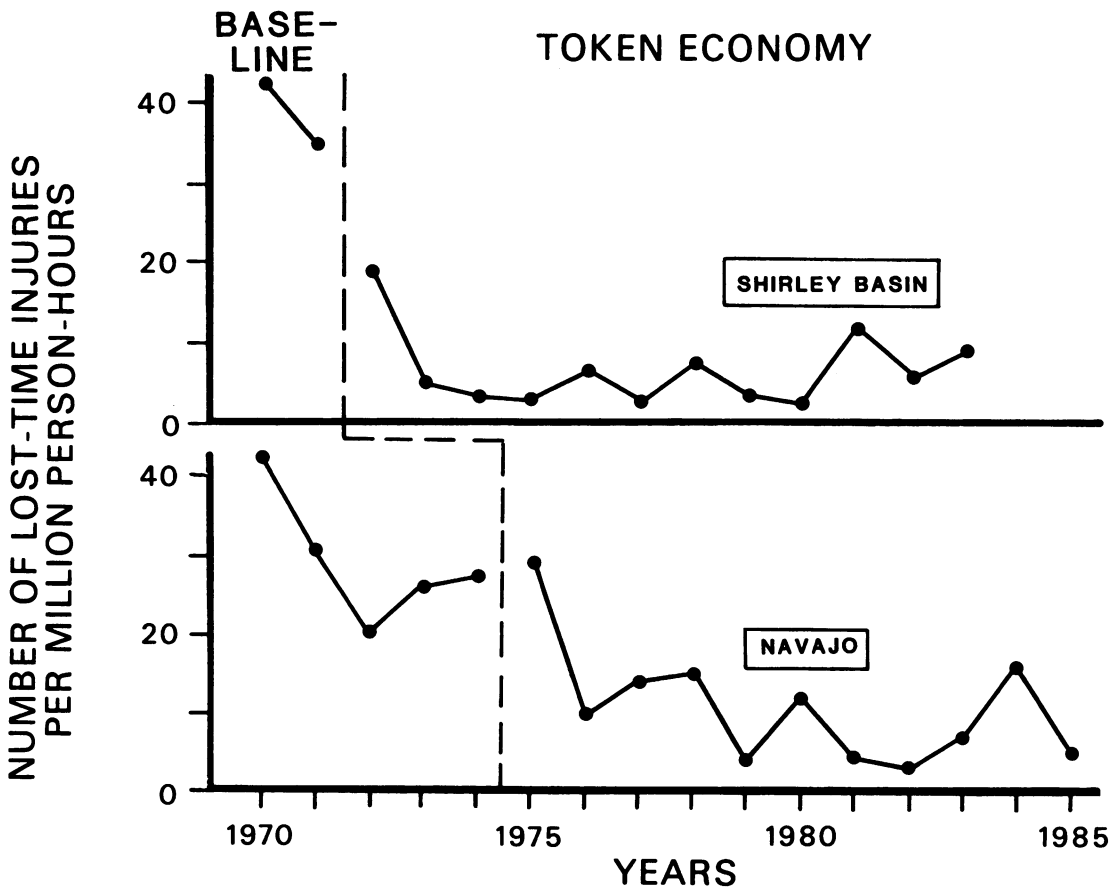

Figure 2. The yearly number of work-related injuries, per million person hours worked, requiring 1 or more days lost from work.

to dollars spent on the token economies (adjusted for hours worked and inflation) ranged from 18.1 to 27.8 at the Shirley Basin Mine and from 12.9 to 20.7 at the Navajo Mine.

DISCUSSION

The tokens given to workers as a consequence of periods without lost-time injuries or equipment-damaging accidents apparently benefitted all parties immediately involved. Both the number of days lost from work and the number of lost-time injuries declined at both mines following the introduction of the token economies. No deaths or permanent disabilities occurred at the Navajo Mine following the introduction of the programs. The number of days lost from work due to injuries during the last 10 years of the token programs was about one-fourth the national mining average at the Shirley Basin Mine and about one-twelfth the national mining average at the Navajo Mine (U.S. Department of Labor, 1984).

In addition to suffering fewer injuries, disabilities, and deaths, the workers earned the benefits of the backup prizes that they received in exchange for their trading stamps. Although not quantified, much anecdotal information suggested that the token programs were generally appreciated by the workers and their families after an early period of skepticism. For example, the local union representing the workers at the Shirley Basin Mine requested that the program be written into the operating contract between the union and company. Early in the first year of the program, the Director

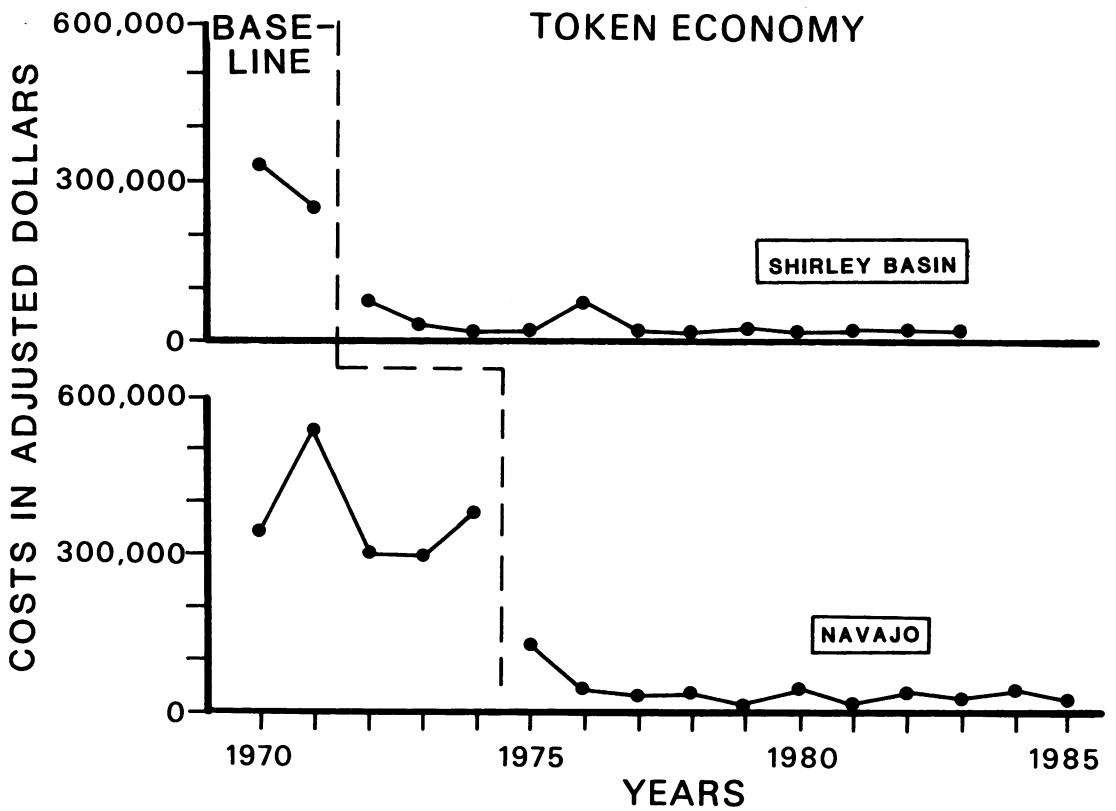

Figure 3. The yearly costs, adjusted for hours worked and inflation, resulting from accidents and injuries.

of Safety and Health at the Shirley Basin Mine conducted a brief probe by leaving the stamps out of eight workers' pay envelopes. The spouse of one affected worker called the mine to demand that the stamps be given to the worker. Another spouse drove over 50 miles to the mine to get the stamps due them.

The Directors of Safety and Health at the two mines benefitted from the programs because they were provided a means of satisfying their major job responsibilities. The programs also led to reductions in the numbers of injuries the Directors had to investigate. Benefits to the companies included the substantial decrease in the costs of accidents and injuries at both mines. Both mine managers speculated that the token economies added to the general morale of the workers at both locations.

The dollar amounts of the reported savings are probably considerably underestimated. Safety researchers commonly estimate that the more difficult-to-measure costs of injuries and accidents often run to several times the direct costs reported here (Sheridan, 1979). These costs include the costs of overtime for workers to replace those injured, lost production resulting from people stopping work to help with accidents and injuries, lost production resulting from equipment having to be repaired, and investigating and reporting accidents.

The estimates of the costs of the token economies may be slightly underestimated because the expenses of providing the token economies do not include the labor costs of administering the token system. However, administration of the program required only about 3 to 4 hr of clerical work each month at each mine.

All of the results are strong evidence that behavioral programs can be faithfully administered and that the effects of those programs can be maintained for extensive periods of time.

The reasons behind the more rapid decline in

the number of days lost from work than in the number of lost-time injuries in both mines are unknown. Distributions of number of days lost from work typically are quite positively skewed with each of many injuries resulting in only a few days off from work and a few injuries requiring many days off from work. The token programs apparently had almost immediate effects in reducing the small number of very serious accidents that accounted for most of the days lost from work due to injuries but only gradually reduced the frequency of less serious accidents. In any case, the days-lost-from-work index is generally considered to be the more important reflection of occupational safety. Changes in this measure directly followed the beginning of the token economies.

The company that operates the coal mine has started two new strip mines in the Navajo area. The management of the new mines has adopted direct replications of the programs reported here. One oil-drilling company has reported the apparently successful use of a similar token economy that was developed following visits by the safety staff to the Wyoming mine (Petree, 1979). The token economy designed by Haynes (1980) for bus drivers was a simplified adaptation of these programs.

Stolz (1984), focusing on tax-supported public human-service monopolies, has suggested that the variable most important in influencing transfer of behavioral technology may be social reinforcement for decision makers. Experimentation will, of course, be necessary to provide answers to questions about transfer of behavioral technology, and different program characteristics may well be important in different settings. However, if the present research represents one example of sufficient conditions for adoption, we would emphasize, perhaps more specifically than in the above observations, that there should be benefits for the adoption, use, and participation of the key people involved in the behavioral program relative to the costs for purchasing and using the program.

In our research, trading stamps were selected rather than some other token because of the large number of backup reinforcers easily provided (Ayllon & Azrin, 1968) and because it was hoped that they might cause workers' families to talk about safety and provide additional social consequences for safe behavior.

The loss of awards for accidents resulting in equipment damage was, of course, intended to reduce damage costs. This may have been particularly important in causing the companies to support the token economies for extended periods of time. From 80% to 90% of the savings in dollars that occurred following the introduction of the token economy was accounted for by reduced damage costs. Therefore, the savings and benefit : cost ratios would have been much lower if the damage costs had not been affected. The injury-related contingencies alone may have produced large reductions in damage costs. However, the inclusion of the contingency for equipment damage is a relatively simple procedure that could be important in generating management support for the entire program.

The reader who would replicate all or part of these procedures should note that extensive training intended to prompt workers to behave safely and maintain safe work conditions was part of the baseline conditions. This training may have been a necessary but not a sufficient condition for the improvements obtained. The replication that fails to include such procedures might not obtain such positive results.

There are three relatively straightforward threats to the validity of the conclusions that the token economies produced the improvements in safety data. One threat is the possibility that the contingencies may have caused workers not to report accidents and injuries. If the token economies had that effect, the changes in data might be, at least partly, a result of decreases in workers' reporting injuries rather than their having fewer injuries. The loss of stamp awards contingent on failure to report an accident or injury was intended to control this. In addition, an injury serious enough to cause a worker to miss work is not easily hidden. The fact that the number of days lost from work declined so dramatically argues that there were actual reductions in the severity of injuries.

Whenever a behavioral intervention is applied to a serious problem, there is a risk that natural variability might include some improvement even if the interventions did not occur. This second threat

is called regression to the mean (Campbell & Stanley, 1963); and may account for the results in the present cases. However, the fact that the treatments were kept in effect for 11 and 12 years without return to the baseline levels of injuries and costs argues that the present effects were not simply regressions to the mean.

A third threat to the validity of our conclusions involves the decreases in both the number of days lost from work and the number of lost-time injuries during the baseline period at the Shirley Basin Mine. These decreases, had they continued, might have produced improvements in safety data at that mine independently of the introduction of the token economy. Either postponing the beginning of the token economy or returning to the baseline conditions after the token economy had been in effect could have provided some evidence regarding this possibility. However, both of these alternatives potentially involved withholding an important treatment from people who seriously needed it.

REFERENCES

American National Standards Institute. (1967). *Method of recording and measuring work injury experience* (ANSI Z16.1-1967). New York: American National Standards Institute.

Ayllon, T., & Azrin, N. H. (1968). *The token economy: A motivational system for therapy and rehabilitation.* New York: Appleton-Century-Crofts.

Baer, D. M., Wolf, M. M., & Risley, T. R. (1968). Some current dimensions of applied behavior analysis. *Journal of Applied Behavior Analysis,* **1,** 91–97.

Campbell, D. T., & Stanley, J. C. (1963). Experimental and quasi-experimental designs for research and teaching. In N. L. Gage (Ed.), *Handbook of research on teaching* (pp. 171–246). Chicago: Rand McNally.

Fellner, D. J., & Sulzer-Azaroff, B. (1984). Increasing industrial safety practices and conditions through posted feedback. *Journal of Safety Research,* **15,** 7–21.

Geller, E. S., Johnson, R. P., & Pelton, S. L. (1982). Community-based interventions for encouraging safety belt use. *American Journal of Community Psychology,* **10,** 183–195.

Haynes, R. S. (1980). *A behavioral approach to the reduction of accidents of city bus operators.* Unpublished master's thesis, University of Kansas, Lawrence.

Komaki, J., Barwick, K. D., & Scott, L. R. (1978). A behavioral approach to occupational safety: Pinpointing and reinforcing safe performance in a food manufacturing plant. *Journal of Applied Psychology,* **63,** 424–445.

National Safety Council. (1986). *Accident facts.* Chicago: National Safety Council.

Petree, P. R. (1979, May 2). Noble Drilling's enviable safety record started Green Stamps. *The Oil Daily,* p. 16.

Rhoton, W. W. (1980). A procedure to improve compliance with coal mine safety regulations. *Journal of Organizational Behavior Management,* **2,** 243–249.

Sheridan, P. J. (1979, March). What are accidents really costing you? *Occupational Hazards,* pp. 41, 43.

Stolz, S. B. (1984). Dissemination of standardized human service models: A behavior analyst's perspective. In S. C. Paine, G. T. Bellamy, & B. Wilcox (Eds.), *Human services that work* (pp. 235–245). Baltimore: Brookes Publishing.

U.S. Department of Commerce. (1971–1986). National income and product accounts tables. *Survey of current business.* Washington, DC: U.S. Department of Commerce, Bureau of Economic Analysis.

U.S. Department of Labor. (1976). *Bureau of Labor Statistics reports on occupational injuries and illnesses for 1975.* (USDL, BLS Report No. 76-1474). Washington, DC: U.S. Department of Labor, Bureau of Labor Statistics.

U.S. Department of Labor. (1984). *Bureau of Labor Statistics reports on occupational injuries and illnesses for 1983.* (USDL, BLS Report No. 84-472). Washington, D.C.: U.S. Department of Labor, Bureau of Labor Statistics.

Van Houten, R., Rolidier, A., Nau, P. A., Friedman, R., Becker, M., Chalodovsky, I., & Scherer, M. (1985). Large-scale reductions in speeding and accidents in Canada and Israel: A behavioral ecological perspective. *Journal of Applied Behavior Analysis,* **18,** 87–93.

Received August 4, 1986
Initial editorial decision November 17, 1986
Revision received February 16, 1987
Final acceptance April 27, 1987
Action Editor, Dennis H. Reid