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PROBLEM SOLVING TO PREVENT WORK INJURIES IN SUPPORTED EMPLOYMENT

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A problem-solving strategy was used to teach three groups of 3 individuals in supported employment how to prevent work-related injuries. The problem-solving strategy was taught in two training phases. The first training phase involved the use of cue cards, and the second involved the withdrawal of the cue cards. Interviews and staged generalization assessments in the participants' natural work environments were conducted before, during, and up to 12 weeks after training. In these assessments, situations were presented that were either similar or dissimilar to situations presented in training. Results of both the interviews and staged assessments indicated that the participants' newly acquired problem-solving skills generalized to similar and dissimilar situations.

DESCRIPTORS: problem solving, injury prevention, supported employment, injuries, staged situations, generalization, maintenance, safety skills

Acquisition of safety skills by individuals with disabilities is important because it increases independence and promotes employability (Martin, Rusch, & Heal, 1982). For example, Mueller, Wilgosh, and Dennis (1989) found that employers in competitive industries in Alberta, Canada, rated safe work behavior and safety awareness as most important for job survival for all employees (i.e., with or without disabilities).

One safety skill area largely ignored in the vocational research literature is work safety. According to the U.S. Department of Commerce (1990), 10,600 workers were killed and 1,800,000 were disabled due to work-related injuries in 1988. The National Safety Council (1991) reported that 60,000 workers received permanent impairments and approximately 1,700,000 received temporary disabilities as a result of an injury sustained while at work in 1990. In addition, the National Safety Council reported that there were 35 million work days lost as a result of work injuries. Finally, work-related injuries cost $63.8 billion; each worker in the United States must produce $540 of goods and services to offset the cost of work injuries. Clearly, these statistics indicate a critical need for safety skills training.

One approach to teaching safety skills in the workplace is problem solving (Hale & Holt, 1986). Problem solving provides a means for individuals to generate solutions across a variety of problem situations. A potentially successful method of teaching problem solving to persons with disabilities was

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Table 1
Characteristics of Participants

Group	Name	Age	WAIS-R* V	WAIS-R* P	WAIS-R* FS	Residential placement	Employment setting
1	Mark	28	79	82	79	Independent	Parks Service
	Ann	36	71	70	69	Independent	Parks Service
	Dan	32	71	71	70	Independent	Department store
2	John	56	79	73	75	Supervised	Forest Service
	Tammy	62	71	76	73	Group Home	Forest Service
	Rob	26	99	80	89	Group Home	Forest Service
3	Larry	41	57	59	54	Family	Cafeteria
	Bob	28	71	67	67	Family	Cafeteria
	Sandy	35	53	62	54	Family	Cafeteria

* V = Verbal; P = Performance; FS = Full Scale.

developed by Foxx, Martella, and Marchand-Martella (1989). With this method, individuals are taught to solve problems by generating initial and alternative solutions considered appropriate by persons who are important in a trainee's environment (e.g., employers, vocational specialists, rehabilitation counselors) (Foxx & Faw, 1990).

The key to any successful training program is to teach skills that generalize and maintain over time. A number of safety skills and problem-solving programs have assessed generalization; however, generalization probes usually included a verbal cue to prompt the behavior (e.g., Edelstein, Couture, Cray, Dickens, & Lusebrink, 1980; Marchand-Martella & Martella, 1990; O'Reilly, Green, & Braunling-McMorrow, 1990; Tisdelle & St. Lawrence, 1988). For example, during generalization assessments, O'Reilly et al. (1990) used the verbal cue, "Let's see how well you can find and fix potential hazards in this room. When you have finished leave the room and tell me that you have finished" (p. 438). Although generalized responding was demonstrated, it is unknown how participants would have responded without the verbal cue.

The present investigation had two objectives. The first was to assess the effects of a problem-solving safety skills program in which participants were taught to prevent work-related injuries. The second objective was to conduct two types of generalization assessments, an interview assessment and a staged assessment. The interview measured the participants' verbal ability to solve problem situations; staged assessments measured the participants' ability to respond appropriately to problem situations without any verbal prompts.

METHOD

Participants and Settings

Nine individuals involved in supported employment services, affiliated with an area vocational training center, participated in this investigation. They were selected by job coaches who indicated that the participants could benefit from such training. Table 1 displays characteristics of the participants.

All baseline, training, and interview assessment sessions were conducted in a small classroom at the vocational training center. This classroom contained a large rectangular table with six chairs and a blackboard. Staged assessments were conducted at the following employment sites: parks (public restrooms), department stores (restrooms and hallways), campgrounds (in and around public restrooms), and the cafeteria (dish room and dining room).

Materials

A list of 24 problem-solving situations were developed through a search of the work-safety literature. These 24 problem situations were sent to six employers and two job coaches who had experience

Table 2
List of Problems Used for Training, Interviews, and Staged Probes

Training	Interview	Staged
	Similar	**Similar**
Box lying in the middle of the aisle	Metal lying on the floor in the aisle	Box in the aisle (path) in the work area
		Piece of twine on the floor (ground)
Water on the floor	Grease on the floor	Ice on the ground
Can of paint near a heat source	Can of spray paint near an open flame	
Exposed electrical wires	Bare electrical wires	
Broken glass on the floor	Nails in the aisle	
Sharp object protruding from a table top	Nail sticking out from a table	
	Dissimilar	**Dissimilar**
Patch of slippery ice on a sidewalk	A hot pan just taken from the oven	Recently extinguished match in the work area
Paper lying on a heater	Power line on the ground	Unlabeled cleaning fluid in the work area
Frayed appliance cord	Smell of gasoline	Empty can with a sharp lid sticking upward
Smoking appliance	Shelf holding heavy objects is about to fall	
Spilled ice on the floor	Disposal of a hot match	
Water dripping from the ceiling onto electrical equipment	Unlabeled cleaning fluid in the work area	

working with individuals with disabilities. The employers and job coaches were asked to provide solutions for each of the 24 problem situations, which they did. These situations were later divided into four criterion components used to score the participants' responses. The four components were: (a) how could an accident happen? (*how*); (b) when would an accident be prevented? (*when*); (c) who would you talk to? (*who*); and (d) what would you do or say? (*what*).

Twelve of the 24 problem situations were used for training; 12 were reserved for interview assessments. In addition, six of these situations were modified in order to use them in the staged assessments conducted in natural settings outside the classroom (see Table 2). Thus, a total of 30 problems formed the training and assessment pool. Half of the interview and staged situations were similar to the training situations and half were dissimilar.

Each training and interview situation was printed on an index card. Each participant received a cue card listing the four problem-solving components and a scoring sheet including nine boxes (labeled from one to nine) on which to record correct solutions.

Data Collection

Data were collected on participant solutions to problem situations, four to five times per week, in sessions lasting from 40 to 60 min. These solutions were compared to the ones provided by the employers and job coaches for scoring.

Measurement of the dependent variable. The dependent measure was the percentage of criterion components present in a problem situation. Criterion components were specific responses required in each solution (i.e., *how, when, who,* and *what*). There were two categories of participant re-

sponses—initial and alternative. An initial response was the first solution to a problem provided by 1 participant. An alternative response was provided by the other 2 participants after the initial response. An alternative response needed to include different responses to the *who* and *what* components than were provided in the other response(s) (i.e., during the initial response and during a previous alternative response if one had been emitted by the 2nd participant).

During training sessions, the trainer recorded on a precoded data sheet whether or not each of the components were present and appropriate in each solution. The interviewer followed the same procedures for interview assessments. Two raters also followed the same procedures; however, the raters' recordings were made at a later time from audiotapes recorded during the training sessions and interview assessments. Some responses were scored as correct without the third (*who*) component if participants correctly stated what they would do. (Scoring rules may be obtained by written request to the first author.)

During the staged assessments, a job coach wrote a description of the participant's response to each problem situation. This description was later categorized into the components by the job coach and two raters. Responses to staged assessments were scored in the same manner as previously described in training sessions and interview assessments. However, the participant's response to the problem situation was observed in the natural environment, and the required response was the response that prevented a work injury, which could range from the single response of moving the hazard (*what*), to several responses, which could include speaking with the supervisor (*who*), identifying the hazard (*how*), identifying what should be done about the hazard (*when*), and removing the hazard (*what*).

The percentages of criterion components completed correctly for training and probe sessions were obtained by dividing the number of correct criterion components by the total number of criterion components possible and multiplying by 100.

Manipulation check. Two components of the independent variable, praise and correction, were assessed by the secondary rater. Appropriate praise was scored when the trainer said "good, you included the ___ component," after the participant independently included a component that was correct in his or her response. The definition of appropriate correction required two components: (a) praise of the attempt or component(s) present and appropriate in a response (e.g., "good, you included the ___ component"), and (b) indication of which component(s) were incorrect or omitted, a request to the participant to provide a solution including the component(s), and provision of the correct response(s) if the participant was unable to do so. Scoring was completed from audiotapes recorded during 25% of the sessions for both training phases.

Experimental Design

To assess the effects of the intervention, a multiple baseline design across the three groups was used (Barlow & Hersen, 1984). Participants in each group were exposed to a baseline condition and two training phases (i.e., training with cue and training with no cue). In addition, generalization probes were conducted throughout the investigation.

Baseline. Training was conducted in groups of 3 participants. The trainer presented 9 of the 12 problem situations per session. These nine situations were selected on a rotating basis (e.g., Session 1 included Situations 1 through 9, Session 2 included Situations 4 through 12, Session 3 included Situations 7 through 12 and 1 through 3, and Session 4 included Situations 10 through 12 and 1 through 6). Situations were rotated to prevent exposure to the same 12 problems every session and to decrease the chances of stimulus satiation. Participants were told to listen to every problem situation and think of an alternative solution. After 1 participant provided an initial solution, the trainer asked the other participants to generate alternative solutions. Thus, each participant generated three initial solutions and six alternative solutions. The trainer did not solve any of the problem situations and did not provide feedback. After the session, participants received monetary compensation for attendance based on their hourly pay rate.

Training with cue. All conditions were the same as in baseline, with the following additions. Participants were given the cue card and scoring sheet. They were instructed to refer to the cue card when formulating a response to a problem situation.

During training, if a correct response was given, the trainer stated, "good answer, you included all of the components." A 50¢ coupon for food or drink at a local restaurant was given to participants when they met or surpassed their own individualized performance criterion. This individualized criterion was based on the number of correct solutions provided by each participant. Initially, the criterion was one correct solution, after which it increased by 33% when a participant met the criterion (e.g., if a participant correctly responded to six situations, the criterion was set at eight in the next session). To help the participants remember their individualized criterion, the number was circled on their scorecards.

If a response was incorrect, the trainer indicated to the participant which component was incorrect or omitted and prompted the correct use of the component. The trainer provided the correct response(s) only when a participant did not. Training terminated after all participants achieved 100% of the criterion components correctly for four consecutive sessions.

Training with no cue. All training conditions remained the same except the cue cards were removed. Again, prompting a correct response was continued if a participant's response was incorrect. Training terminated after all participants achieved 100% of the criterion components correctly for four consecutive sessions.

Generalization and maintenance probes. Generalization probes were conducted before baseline (PP), after baseline (P-1), after training with cue (P-2), after training with no cue (P-3), and 2, 6, and 12 weeks (maintenance) after training ended. These probes included interview and staged assessments of situations that were either similar or dissimilar to those used in training. Similar situations required the same response as the parallel training situation. Dissimilar situations required a different response than the one in the training situation.

During the interview assessments, 12 situations (six similar and six dissimilar) were presented verbally to each participant by an interviewer. Following the presentation of each problem situation, an instructional cue ("What should you do or say?") was delivered by the interviewer. During the staged assessments, six situations (three similar and three dissimilar) were staged in each participant's work environment. The three similar situations were subsets of the training and interview situations, and the three dissimilar situations were situations distinct from those used in the interview assessments. During these assessments, a job coach told each participant to complete a task that did not involve the staged situation (e.g., "clean the sink," when there was glass on the floor, as opposed to "sweep the floor"). The participant's response to the staged situation (broken glass) then was assessed. No cue or feedback was provided during or after these situations.

Social Validation

The 9 participants and their job coaches rated their satisfaction with the training program on five items after the training program ended. Ratings based on a 5-point Likert-type scale ranged from 1 (strongly agree) to 5 (strongly disagree). The rating forms were distributed by a vocational specialist.

Interobserver Agreement

One rater served as a secondary rater and independently scored the training sessions from audiotapes. An additional rater, naive to the design and intent of the study, scored the training sessions from audiotapes. The naive rater was provided a scoring matrix used by the trainer, observers, and secondary rater. This scoring matrix included all of the problem situations and a sample of correct responses to the criterion components.

Generalization probes were scored by the interviewer (interview assessments) or the job coach (staged assessments), as well as the secondary and naive raters. During interviews, participants' re-

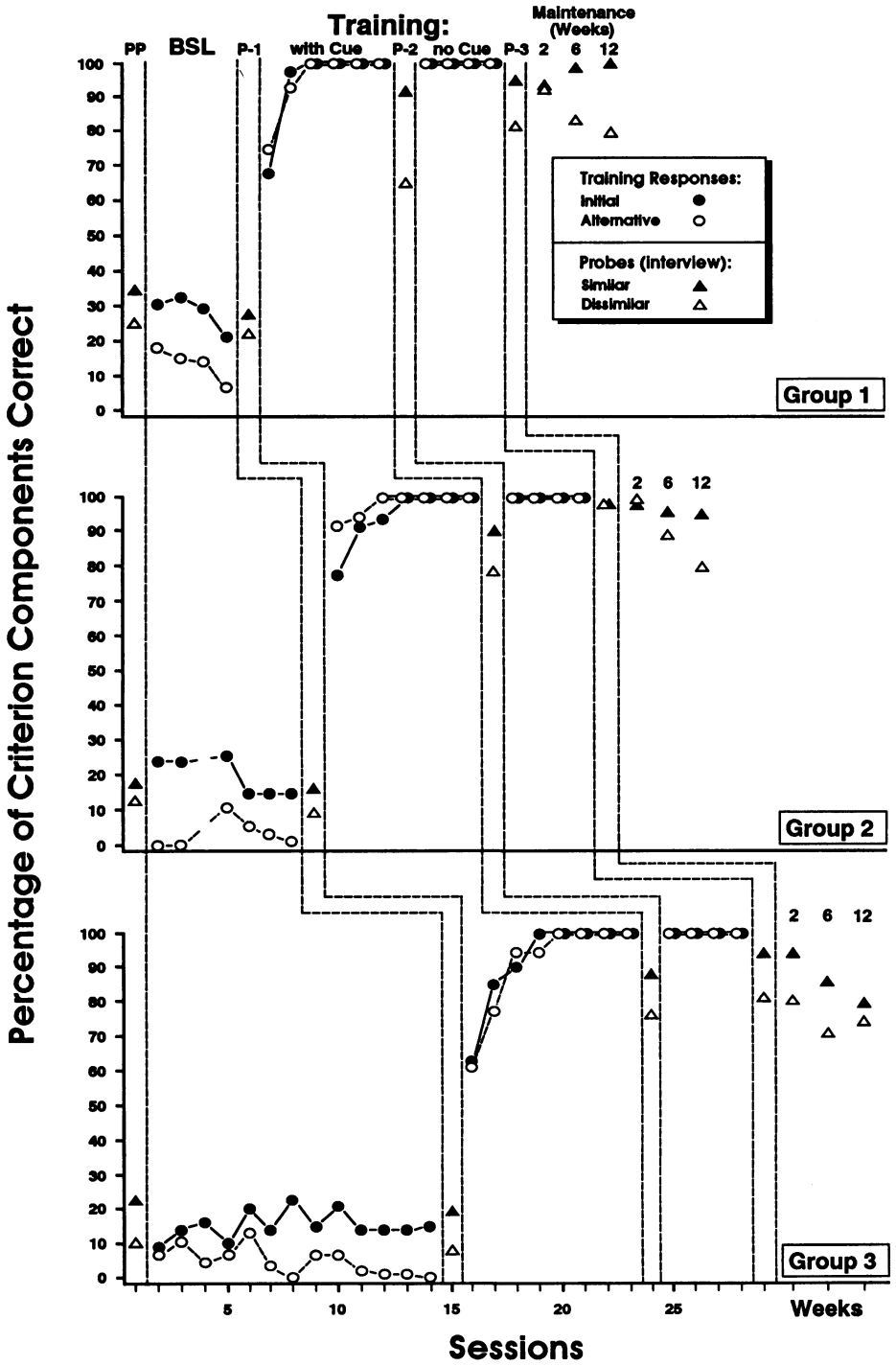

Figure 1. Percentage of criterion components correct across baseline, training, and generalization and maintenance probe sessions for Groups 1, 2, and 3. PP represents the pretest probe, and P-1, P-2, and P-3 represent probes conducted after each phase.

sponses were audiotaped and scored by the secondary and naive raters. During the staged assessments, written records were scored by the secondary and naive raters.

Interobserver agreement was calculated during approximately 25% of the baseline and training sessions and 100% of the interview and staged generalization assessments. Interobserver agreement was calculated by dividing the number of agreements of criterion components correct by the number of agreements plus disagreements of criterion components correct and multiplying by 100 (Hall, 1983). The range of mean interobserver agreement scores for correct and incorrect responses across participants, groups, and sessions during baseline, training with cue, and training with no cue exceeded 90%. The mean interobserver agreement scores across all interview assessments across all staged assessments likewise exceeded 90%.

RESULTS

Baseline and Training

Figure 1 shows group averages for initial and alternative responses. During baseline, Groups 1, 2, and 3 averaged 15% to 28% and 4% to 13% for initial and alternative responses, respectively. When the training with cues was implemented, the mean range for the three groups was 92% to 95% for initial responses and 91% to 98% for alternative responses. During training with no cues, all three groups averaged 100% for initial and alternative responses.

Generalization Probes

As shown in Figure 1, the percentages of correct criterion components for the participants in the three groups increased across the interview assessments for similar and dissimilar situations from the pretest probe (PP) to the training with no cue probe (P-3). All group responses generalized to similar and dissimilar situations.

As shown in Table 3, all three groups had improved percentages in the staged assessments from the pretest to the training with no cue probe for similar and dissimilar situations.

Table 3
Group Performance During Staged Assessments for Similar and Dissimilar Situations

	Groups		
	1	2	3
Pretest			
Similar	0	0	0
Dissimilar	20	8	0
Baseline probe (P-1)			
Similar	0	0	0
Dissimilar	20	0	0
Training with cue probe (P-2)			
Similar	29	64	88
Dissimilar	33	0	40
Training no-cue probe (P-3)			
Similar	91	78	89
Dissimilar	82	86	33
Maintenance (2 weeks)			
Similar	78	56	67
Dissimilar	67	67	50
Maintenance (6 weeks)			
Similar	89	90	67
Dissimilar	71	50	50
Maintenance (12 weeks)			
Similar	50	67	67
Dissimilar	75	67	50

Maintenance

For the interview covering similar and dissimilar situations, the percentages were maintained with small fluctuations for Groups 1, 2, and 3 (see Figure 1). For the staged similar situations, fluctuations for Groups 1 and 2 were noted. The largest decrease for Group 1 occurred from the 6-week to the 12-week probe. For Group 2, the largest decreases were noted from the training with no cue probe to the 2-week probe and from the 6-week to the 12-week probe. Group 3's percentages were maintained throughout the maintenance condition.

Manipulation Check

The mean percentage for the appropriate delivery of praise across groups was 99% (range, 87% to 100%). The mean percentage for the appropriate delivery of corrections across groups was 92% (range, 88% to 100%).

DISCUSSION

The results indicated that the training program increased the problem-solving skills of all groups when they used cue cards. Furthermore, these skills were maintained when the cue cards were eliminated. In addition to the acquisition of skills, several findings from the interview assessments are worth noting. First, participants' performances improved not only for situations similar to those used in training but also to situations dissimilar to those used in training. Therefore, the findings suggest that participants learned to generate new solutions to novel problem situations. Generating new responses is important, because the goal of problem-solving training is to teach individuals to generate solutions to situations they have never encountered (Hale & Holt, 1986).

The most important aspect of any training program is determining whether the participants can respond appropriately in natural environments (Spooner, Stem, & Test, 1989). According to Foxx and Faw (1990), a more rigorous assessment of generalization than the use of verbal cues involves assessing if participants taught to solve problems verbally could do so in the absence of verbal cues. In the present investigation, additional generalization assessments (i.e., staged) were conducted to measure the extent to which training in verbal problem solving affected responses to potential injury-causing situations in work environments. In this investigation, skill performance generalized to staged situations in various work environments. Generally, the participants' responses to situations similar to those used in training improved. More important, all participants showed improvement in staged situations dissimilar to the training situations. Therefore, the results suggest that a problem-solving strategy taught to persons in supported employment in a classroom setting can produce generalized responding in natural work environments.

An important finding was that the performance of all groups was maintained above pretest and baseline probe levels in both interview and staged assessments for up to 12 weeks following training. However, at times, performance levels in maintenance probes decreased somewhat from the peak levels reached in training. One reason for this decrease over time may be simply that there were no consequences to maintain the behavior. Unless an employer provides contingencies to prevent work injuries, optimal maintenance may not be achieved. Considering the lack of supporting contingencies in the present investigation, the maintenance performance was surprisingly robust.

The social validity reported in this investigation was an additional desirable finding. The solutions to the problem situations were developed by employers and job coaches. In addition, feedback from the job coaches and participants showed that they were satisfied with the program and believed it to be worthwhile.

Although there were a number of important findings in this investigation, some caveats and areas for future research are noteworthy. First, the number of staged situations was limited and, thus, conclusions based on their results must be made with caution. Second, although performance in the staged assessments was robust, a staff member was involved in these assessments. Thus, participant performance may not have been as desirable if no overlap in personnel between training and generalization probe settings occurred. Third, repeated exposure to staged situations led to improved performance in probes. Therefore, the effects of training on performance in generalization probes may be confounded with repeated exposures. Future research should attempt to control for the possibility of learning by incorporating more probes throughout the baseline condition and measuring the changes that occur. Finally, during the staged assessments, interobserver agreement on the actual occurrence of responses was not obtained. Instead, interobserver agreement assessments were conducted on the responses as described by the job coach. Future re-

search should attempt to conduct assessments for purposes of interobserver agreement directly on responses rather than on a description of those responses.

In summary, the present investigation demonstrated that individuals in supported employment can be taught a problem-solving strategy to prevent work-related injuries. More important, the participants applied this strategy to similar and dissimilar situations in interview assessments and staged (workplace) assessments. In addition, the participants' performance was maintained and continued to improve up to 12 weeks after training ended. This investigation is especially timely, given the paucity of such training programs in the research literature and the importance of injury-prevention skills to both employees and employers in the work environment.

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