Effect of creative thinking on OHS committees

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An important principle of Australian OHS law is that workers participate in the management of health and safety via OHS committees and representatives. A further principle is that workplaces engage in problem-solving processes according to a hierarchy of hazard control — rather than simply following prescriptive rules. The OHS committee is therefore a problem-solving forum. However, the benefits of problem-solving or creative thinking techniques within committees have not been widely explored. To test the effects, two OHS committees from two construction companies were trained in a combination of creative thinking and risk control concepts. Subjects were tested on their ability to generate solutions and to rank solutions. They were compared with untrained subjects from two further committees. The results showed that the trained subjects generated more solutions and, when ranking solutions, showed a greater preference for solutions which were higher on the hierarchy of controls.

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- CONSTRUCTION INDUSTRY
- CREATIVE THINKING
- PROBLEM SOLVING
- OHS COMMITTEES

Introduction

Australian workplace safety law follows the model outlined by the Robens investigation in the United Kingdom. Two important principles from Robens are that: (1) workers participate in the management of safety; and (2) the workplace safety statutes should pivot on a "clear statement of the basic principles of safety responsibility".[1] An example of an Australian statute is the *Occupational Health and Safety Act 2000* (NSW) (like its predecessor the *Occupational Health and Safety Act 1983*). The Act itself goes into little detail regarding specific safety measures and instead centres on a simple statement regarding the employer's duty of care (section 8(1)). While the Act is essentially a self-regulating model (like others in Australia), it relies on a mix of standards to attain the right levels of safety. The *Occupational Health and Safety Regulation 2001* (NSW) provides examples of these:

— **prescriptive standards (for example, tractor roll-over protection)**: prescriptive standards define a solution for a given problem. For example, the requirement for tractors to be fitted with roll-over protection (clauses 93, 104, 130, 141);

— **performance standards (for example, noise exposure limits)**: performance standards define an end-point but do not specify the methods of achieving that end. An example is the limit on noise exposure to an 8-hour equivalent of 85 dB(A) and peak of 140 dB(C) (clause 49); and

— **process standards (for example, the hierarchy of control)**: process standards usually specify a problem-solving model. They are seen as being broadly applicable and adaptable to change. In contrast, many prescriptive requirements were seen by the Robens Committee as "outdated, over-complex and inadequate".[2] The Industry Commission agreed with this view, noting that: "Requirements that prescribe particular processes impose high compliance costs, stifle innovation, prevent the evolution of best practice and contradict the notion of continuous improvement."[3]

The NSW *Occupational Health and Safety Regulation 2001* consists mainly of problem-solving processes rather than set solutions. A key part of this is the hierarchy of hazard control (clause 5):

1. elimination;
2. substitution;
3. isolation;
4. engineering;
5. administration; and
6. personal protective equipment.

The priority is to seek hazard controls "at the source" through elimination or substitution. These controls need not be implemented if they are impracticable, but they should be sought and explored in the first instance. However, high-order controls often appear impractical when first examined. For instance, eliminating an item of plant will often seem to be counterproductive to productivity. Higher-order controls can be easily dismissed as "impractical" and the thinking quickly falls down the hierarchy until less-challenging options are arrived at, such as personal protective equipment. To achieve high-order controls it is necessary to have the ability to rethink the way the work is done. Creative thinking skills are therefore needed.

Worker involvement in safety is usually achieved through safety representatives and/or committees. When this research was conducted, the *Occupational Health and Safety Act 1983* (NSW) provided only for committees. The 2000 Act provides also for representatives but committees continue to be an important forum for consultation. While some writers view committees as being effective, others are not convinced and some say that they become stagnant and ineffective and that committee training leaves much to be desired.[4–10] Alternative skills for committees should therefore be explored.

Because the authors of this article felt that creative thinking could play an important role, this project aimed to determine what effect creative thinking training would have on committees. This project is an

extension of an earlier study that explored the relationship between creative thinking methods and safety problem solving.[11,12] That study used control and experimental groups with various types of subjects. The intervention consisted of de Bono's Six Thinking Hats method and the effect was tested with a series of problem-based exercises.[13] The main outcome was that trained subjects outperformed untrained subjects when generating solutions. A natural extension of that project was to determine the effects in an applied setting (construction industry safety committees were chosen to test this).

Methods

Subjects

Four OHS committees from two major companies in the NSW construction industry participated in the project. Each committee consisted of eight male members and each had equal numbers of employee and management representatives. However, only 12 of the 16 members of the two trained committees attended the training (six from each committee) and of these, eight were employees and four were management.

Intervention: combined creativity and OHS training

Two of the four OHS committees (one from each organisation) were randomly chosen to take part in a one-day training session conducted by John Culvenor. The training included:

1. the need for creative thinking in OHS problem solving;
2. the principles of accident prevention in terms of the control at source model and hierarchy of control model; and
3. creative thinking methods in the form of the Six Thinking Hats method (the training materials were donated by Advanced Practical Thinking Training of De Moines, Iowa, United States). The Six Thinking Hats technique was chosen because it is a simple method and was successful in the earlier study.[11,12] Each of the coloured hats represents a different element or type of thinking. Briefly, the colours and their corresponding definitions, as defined by de Bono, are shown in Table 1.[13]

The inclusion of safety-specific material was something of a departure from the methods of the earlier study.[11,12] In that study, creative thinking training alone was used for most of the experiments. However, for one group there was a combination of creative thinking training and hazard management training (two days), and some comparisons can therefore be drawn.

Evaluation

Six weeks after completion of the training, the members of all four committees completed an exercise which comprised four hypothetical OHS case studies (see Appendix at p 246).

Case studies 1 and 2: the first two case studies were specifically created for this project and concerned the following (both in construction settings): (1) a noise problem; and (2) a chemical issue. In response, subjects were to generate as many potential solutions as possible in four minutes.

Case studies 3 and 4: the third and fourth case studies were drawn from the previous study and involved two plant hazards in a non-construction setting.[11] For both of these case studies there were six

TABLE 1

Six Thinking Hats definitions

Hat colour	*Definition*
Blue hat	Concerned with the control and organisation of the thinking process.
Green hat	Covers creativity and new ideas.
White hat	Neutral and objective; concerned with facts and figures.
Yellow hat	The positive hat; covers optimism and positive thinking.
Black hat	Covers the negative aspects: why it can't be done.
Red hat	Gives the emotional view.

TABLE 2

Generating solutions (number of solutions)

	Untrained			*Trained*			*t-test*	
Case study	*N*	*Mean*	*SD*	*N*	*Mean*	*SD*	*T*	*P (one tail)*
1	12	4.3	1.8	12	5.2	1.8	1.14	0.133
2	12	3.6	1.1	12	4.9	1.7	-2.31	0.015

potential solutions proposed and subjects were required to rank these in order of effectiveness in the absence of considerations of practicalities such as cost (three minutes for each case study).

Data analysis

The number of solutions were "count-type" data. Tests of normality were conducted (Kolmogorov-Smirnov) and the data determined to be normally distributed. Independent sample one-tailed t-tests were used as it was expected that the training intervention would result in an improvement in the generation of ideas.

The quality of solutions was measured by classifying each solution into one of two categories: (1) "safe place"; or (2) "safe person". The proportion of safe-place solutions was then calculated and this was the variable analysed. Elimination, substitution, engineering, etc, controls were classified as safe place. Administrative and personal protection and other solutions requiring particular behaviour on the part of the person at risk were classified as "safe person". Tests of normality (Kolmogorov-Smirnov) were conducted and the data determined to be normally distributed. The data were analysed using independent samples t-tests. One-tailed tests were used because the training included risk control concepts and an improvement in solution quality was expected.

In their raw form, the ranking of solutions resulted in ordinal data. That is, for each of the problems, the solutions were ranked from one to six. The ordinal responses were correlated (Spearman) with a preferred order which was based on the hierarchy of control principles (in the same manner as per the previous study). These Spearman correlations were the variables analysed (ranging from -1 to +1 on an interval scale). Tests of normality (Kolmogorov-Smirnov) were conducted and the data determined to be normally distributed. However, it was decided to follow the previous analysis method where the data were non-normal and the non-parametric Mann-Whitney U test was employed (note that a different method is described in Culvenor and Else).[11,12] One-tailed tests were used because the training included risk control concepts and an improvement in the ranking of solutions was expected.

Results and discussion

Generating solutions

As shown in Table 2 and Figure 1, the data show an increase of 21% (Case study 1: not significant) and 36% (Case study 2: statistically significant) in the number of solutions generated by those who undertook the training. This result is less than that found previously for creative thinking training alone.[11] The improvements in that study were in the order of 60–150% for undergraduate engineering and technology students but improvements were somewhat lower for industry and government safety advisers (20–50%). Subjects experienced in safety responded less well. The subjects in the present study (OHS committee members) are probably better matched to the industry and government safety advisers than they are to the undergraduate students and so an improvement here of 21–36% is about what would be expected. But what of the addition of the risk control concepts? As noted, the previous study only examined this for one group of subjects (government

TABLE 4

Making decisions about risk control (correlation of subject ranking with preferred ranking according to the hierarchy of control)

	Untrained			*Trained*			*t-test*	
Case study	*N*	*Mean*	*SD*	*N*	*Mean*	*SD*	*U*	*P (one tail)*
3	12	-.44	.47	12	.17	.44	20.0	0.002
4	12	-.46	.57	12	-.29	.39	46.5	0.143

In the South Australian study on health and safety representative (HSR) training the same method was used.[14] The mean scores for problems 3 and 4 of 50 untrained HSRs were -0.50 and -0.57, respectively. Immediately following the safety representative training, the mean scores had improved to -0.29 and -0.34, respectively. However, this effect appeared to be not sustained over time. The untrained scores in the present study are similar to the scores of untrained HSRs in SA. The post-training scores noted here seem somewhat better and this might be explained by the greater focus on the hierarchy of control issues in the short intervention used in this study. Further, the improvement noted here was obtained with a test that took place six weeks after the training whereas, as mentioned above, the immediate effect recorded in the SA study did not seem to be sustained over time.

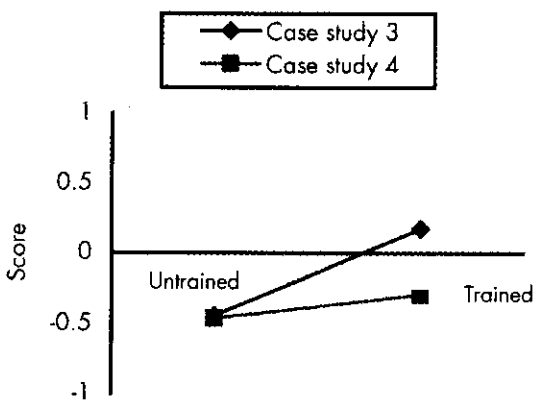
It has been established in a number of surveys that the careless worker/blame the worker way of thinking is common in Australia.[14–20] This stereotypical way of thinking is an impediment to the application of higher-order controls, and the trend towards a preference for safe-place controls among the trained group in this study is encouraging. While all the participants in the training had previously attended OHS committee training, enhanced knowledge of risk control concepts is important and greater emphasis on these would be welcome.

Conclusion

In terms of the application of creativity skills in safety, this small study indicated that combined creativity and accident prevention concepts training could lead to the

FIGURE 2

Making decisions about risk control (correlation of subject ranking with preferred ranking according to the hierarchy of control)



APPENDIX
Case studies

Case Study 1: Noise (task: generate solutions)

"Noise is a major hazard at the workplace. To carry out certain aspects of construction work, a mobile compressor is often used. These can be very noisy. On this particular day, we find a compressor in the middle of about 20 construction workers, working on an unfinished floor of a small multistorey building site. The compressor's noise output is about 100 dB(A), far in advance of the legal requirement, which is 85 dB(A)."

Following are the combined solutions developed by subjects. The researchers divided these into "safe place" and "safe person" categories. The proportion of safe place solutions in each subject's set of solutions was then calculated using these categories (the same approach was applied to Case Study 2, below).

Solutions classified as safe place: use electric tools; stop compressor; use electric compressor; change compressor (less noise); set up compressor in another area (using longer hoses); build sound barriers/baffles around compressor; use acoustic panels around compressor; use a silencer on compressor; insulate engine compartment; service compressor to make quiet; stagger hours/out-of-hours work; rotate workforce; limit number of workers in area; relocate workers away from compressor.

Noise solutions classified as safe person: conduct noise monitoring; isolate area using warning; use signage; manage trades in area; change work methods in area; use personal hearing protection (hearing plugs/muffs).

Case Study 2: Chemicals (task: generate solutions)

"Toxic chemicals/glues are a hazardous part of many construction sites. Dave, a vinyl layer, needs to use an extremely toxic epoxy mix to complete his job of finishing the vinyl floor. While using this mixture on a vinyl floor in a small kitchen, Dave becomes very sick and collapses, and is rushed to hospital. Dave's company has said that, although the mixture is quite toxic, it is the best and most economical product for the job and, besides, they told Dave to use a respirator when using the product."

Solutions classified as safe place: use alternate floor type; use another glue/product; use a less hazardous epoxy; isolate employee; use a ventilation system; use extraction fans; have shorter shifts; rotate workforce.

Chemical solutions classified as safe person: train worker about danger/use of PPE/ safe work methods; use MSDS; work in pairs; use signage; increase supervision; warn other workers; adhere to safe work methods; prosecute company; sack worker and supervisor; use masks and breathing apparatus; use first aid equipment; use radio/phone for emergencies.

Case Study 3: Plant (task: rank solutions)

"Aircraft fitters inspect aircraft before each flight. To gain access for inspection, Jim, an aircraft fitter, stood on a tug. A tug is a flat-topped vehicle designed for towing aircraft and luggage trailers, etc. Jim was able to stand on the tug, inspect the aircraft and drive around underneath the aircraft by operating the controls away from the driver's seat. Jim was moving the tug to a new inspection point when he collided with the aircraft. The collision trapped Jim between the tug and the aircraft fuselage. Jim received multiple fractures to his upper body. The company rules are that tugs are operated only if the driver is seated in the driver's seat."

Options (in order given — preferred rank shown in parentheses): reduce the height of aircraft landing gear (1); institute an employee incentive scheme promoting safe practices (6); provide a special motorised maintenance trolley (3); provide training to the fitters in safe equipment use (4); increase aircraft component reliability (2); increase supervision to ensure compliance with safety rules (5).

Case Study 4: Plant (task: rank solutions)

"Kelly is a gardener at a metropolitan hospital. Kelly was cleaning a "gang" mower when she cut her foot. Kelly had seen other gardeners clean the mower by hosing the blades with water while operating them in reverse. Kelly was washing the mower in this way when her left foot touched the moving blades. The blades left deep cuts in her big toe and two adjacent toes. There had been no verbal or written instruction about how to wash the mower safely. The hospital provides safety boots but Kelly was not wearing them at the time of the accident. Often outdoor workers wear their own shoes claiming that they are more comfortable. The hospital has now developed a code of practice for the safe operation of the gang mowers."

Options (in order given — preferred rank shown in parentheses): provide training in the new code of practice (5); remind all outdoor staff to wear safety boots (4); use sheep to graze the grass (1); purchase a self-cleaning mower (2); re-sow the grass with a slower growing native variety (3); provide training away from the workplace in hazard recognition and reporting (6).