



Behavior-Based Safety Management in Hong Kong's Construction Industry

Helen Lingard and Steve Rowlinson

A behavior-based approach to industrial safety management has been advocated by many authors and has been found to effectively improve safety performance in different industrial settings and on different continents. This paper reports on the implementation of a behavior-based safety management program in the Hong Kong construction industry. The behavior-based safety management techniques of performance measurement, participative goal setting, and the provision of performance feedback were introduced in a carefully controlled field experiment on seven public housing construction sites in Hong Kong. The paper describes this experiment and explains how the program was implemented. The results of the experiment were mixed. Behavior-based safety techniques were highly effective in bringing about improved performance in site housekeeping, but significant improvements in access to heights were only observed on two of the seven sites, and there was found to be no significant improvement in the use of bamboo scaffolding during the experimental intervention. The paper presents these results and discusses factors that may have contributed to the limited effectiveness of the techniques in the latter two performance categories. © 1997 National Safety Council and Elsevier Science Ltd

INTRODUCTION

Hong Kong's construction industry has an unenviable safety record. In 1994, an accident rate of

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280 accidents per thousand workers was recorded. The worst year on record for construction fatalities was 1993, with 80 workers losing their lives in the course of their employment. This number represents 87% of all industrial fatalities occurring in Hong Kong during that year.

The construction site safety problem in Hong Kong is complex, with many factors contributing to this poor performance. In Hong Kong, worker involvement in trade unions is limited. The proportion of unionized construction workers fell from 15% in 1976 to only 8% in 1986 (Turner, Fosh, & Ng, 1991) and unions are not in a strong position to push for improved safety standards.

The predominance of multilevel subcontracting renders it difficult to effectively control site safety. Lai reports that, of 17 building contracts

examined, the amount of work subcontracted was never less than 92.5% (Lai, 1987). Under these conditions, there is often disagreement as to who is responsible for implementing basic site safety measures. Subcontracted workers are often paid on a piece rate basis and the incentive to cut corners, to the detriment of site safety, is great.

The Hong Kong Government's intervention in industrial safety matters is limited. The Factory Inspectorate of the Government's Labour Department is responsible for inspecting sites and prosecuting offenders found to be in breach of safety regulations. However, the ratio of notifiable industrial workplaces to inspectors exceeds 400:1 (Williams, 1990). Despite the fact that violations of the law are commonplace, only 4% of all inspections result in prosecutions (*Hong Kong Standard*, 1990). When a construction firm does face prosecution, the fine imposed is often a derisory sum. These factors limit the effectiveness of the industrial safety and health legislation.

It was in this difficult context that a field experiment was carried out with the objective of evaluating the effectiveness of behavior-based safety management.

BEHAVIOR-BASED SAFETY MANAGEMENT

Behavior-based safety management techniques aim to motivate employees to improve their performance. In most instances, an analysis of hazards associated with an employee's job is carried out and specific behaviors representing safe and unsafe practices are identified. These behaviors then become central to the measurement of employees' safety performance. Measurement is carried out, using a behavior-specific instrument, by directly observing employees at work. Motivational activities that focus on the desired behavior are then implemented and employees' behavior is monitored.

Formal performance goal setting is a motivational technique commonly adopted by applied researchers. In some studies, goal setting has been implemented with other motivators, such as the provision of token incentives (Haynes, Pine, & Fitch, 1982; Zohar, 1980), the provision of feedback on individual performance (Zohar, Cohen, & Azar, 1980; Haynes et al. 1990), the provision of feedback on group

performance (Komaki, Barwick, & Scott, 1978; Fellner & Sulzer-Azaroff, 1984; Mattila & Hyodnmaa, 1988; Duff, Robertson, Phillips, & Cooper, 1994), team competition (Haynes et al., 1982) and training (Komaki et al., 1978; Duff et al., 1994).

A review of this literature strongly suggests that behavior-based safety management systems do bring about improved industrial safety performance. Most notably, two recent studies indicated that behavior-based safety management can be effective, even in the difficult construction setting (Duff et al., 1994; Mattila & Hyodnmaa, 1988).

Goal Setting

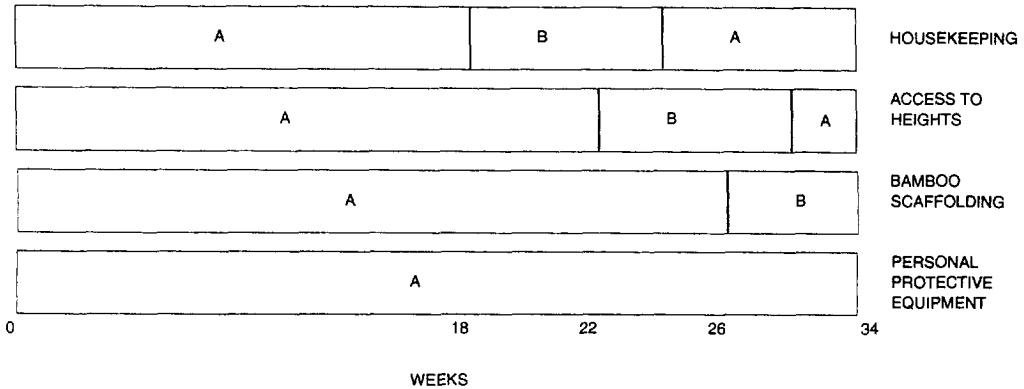
A goal setting theory of motivation was developed by Locke (1968). The theory holds that goals or intentions, which an individual has consciously decided to pursue, are the most powerful determinant of that individual's subsequent behavior. Any reward or incentive offered to an individual will elicit a higher performance level only insofar as it causes the individual to consciously change his or her goal or intention. Goal setting, as a motivational technique, has been found to be effective in bringing about improvements in many different aspects of work performance (Latham & Yukl, 1975).

Locke, Shaw, Saari, and Latham (1981) reviewed applied goal setting research and revealed the following findings. Goals must be accepted by an individual if they are to be effective motivators. If a goal has been accepted, harder goals yield higher performance than lower goals, and monetary or tangible rewards can increase an individual's commitment to goal attainment. Individuals must also be capable of performing well if goals are to be effective.

Experiment Design

Traditional methods of evaluating the effect of an intervention are not appropriate for use in industrial settings as they rely upon the random assignment of subjects into control and experimental groups. This cannot usually be arranged in a work environment and the violation of this assumption, by using existing work teams or departments as control and experimental groups, has been a methodological flaw in previous behavioral safety research (Smith, Anger, & Usilan, 1978; Zohar et al, 1980).

Figure 1: Experiment design



Note:

A denotes baseline conditions

B denotes the intervention phase (goal setting and performance feedback)

An alternative to traditional experiment designs involves the drawing of comparisons within the same group of subjects (Barlow & Hersen, 1984). Within-group experimental designs have been used by the majority of researchers assessing the effectiveness of behavior-based safety techniques in industrial settings. A combination of the multiple baseline and withdrawal within-group experiment designs was used in the Hong Kong construction study. Figure 1 is a graphic representation of the experiment design.

Four categories of safety behavior were identified and measured during the experiment. These were: housekeeping, access to heights, bamboo scaffolding, and personal protective equipment (PPE). After a period of baseline measurement using a predesigned measurement instrument (see Measurement section below), participative goalsetting and performance feedback were introduced to the housekeeping, access to heights, and bamboo scaffolding categories at staggered intervals. PPE was maintained as a control category, and thus no intervention was introduced in relation to the use of PPE.

It was expected, if the interventions were effective, that performance in a given category would only improve when the intervention was introduced with respect to that category. Thus, with reference to Figure 1, housekeeping should improve on all sites after week 18, access to

heights should improve after week 22, and bamboo scaffolding should improve after week 26. No improvement in PPE should have been observed.

Measurement in all four categories continued until week 34 of the experiment and this enabled a comparison to be made between performance during the intervention and performance following the removal of the performance feedback in the categories of housekeeping and access to heights. A deterioration in performance following the removal of performance feedback would lend further weight to the argument that any improvement could be attributed to the implementation of goal setting with feedback.

Measurement

A proportional safety measurement instrument was developed for use in the research. The proportional measurement of safety performance was advocated by Phillips (1992) and a similar instrument was used by Duff et al. (1994) and was found to possess a high degree of interrater reliability. Items were selected for inclusion in the safety performance measure on the basis of detailed statistical analysis of past accidents on Hong Kong Housing Authority building construction sites (Lingard & Rowlinson, 1994). Items had to be clearly defined, easily observable, and relevant at all (or most) stages of the construction process.

Measurement was carried out by a trained and appropriately qualified observer with relevant site experience. The observer was not informed as to the purpose of the measurement, so as to reduce the possibility of observer-induced bias. Each item was scored proportionally; for example, the observer would record the number of unsecured ladders that he observed in use as a proportion of the total number of ladders in use on the site. Items were rated on a scale from 0 to 10. Zero indicated full compliance and 10 indicated total noncompliance with pre-established safety standards.

Measurement was carried out twice weekly on all seven sites. Sites were visited on different days of the week and at different times of day each week and site staff were never forewarned as to when a site visit was to be made. Reliability was assessed 18 times during the course of the experiment. Assessments involved the observer and the researcher independently and simultaneously measuring a site's safety performance. The average percentage agreement between observers was 78%, but in most cases the agreement was greater than 80%. This is deemed to be an acceptably high level of agreement.

The Sample

All of the experimental sites were Hong Kong Housing Authority (HKHA) building construction sites. These sites were an ideal environment in which to experiment with behavior-based safety management techniques. HKHA sites represent a reasonably homogeneous sample as construction design and specifications vary little from site to site. Client-based safety management activities, which have been found to have a considerable impact upon construction safety performance (Levitt & Samelson, 1987), are also uniform.

Intervention Protocol

When safety performance had been measured for 17 weeks, goal-setting meetings were held in the housekeeping category. These meetings were held in site offices and, typically, the project manager, the site safety officer, and a small group of workers attended the meetings. The meetings were conducted by a researcher who showed a series of slides depicting good and bad practice in the area of site housekeep-

ing. Housekeeping items were explained and safe practices discussed.

Those present were then introduced to the housekeeping feedback charts, on which the site's performance in housekeeping for the 8 weeks prior to the meeting had been marked. Feedback charts were marked with a title in English and Chinese and had two axes. The y axis represented weekly performance expressed in percentage terms, and the x axis represented 16 weeks.

Workers and site staff were asked to suggest a realistic (i.e., attainable) target level for housekeeping performance. Participative goal setting was encouraged since Cooper found safety performance goals that were set with worker participation to be more effective than goals that were simply assigned by researchers or by management (Cooper, 1992). Following a discussion between those present at the meeting, a target performance level was unanimously agreed.

Once the target was set, it was explained that the goal would be marked on the chart in red and that the site's actual level of safety performance would be updated once each week. The charts were placed in a prominent position on the site. After 8 weeks of measurement and feedback, housekeeping charts were removed and no further performance feedback relating to housekeeping was given.

After 21 and 25 weeks of measurement, the same goal setting and feedback process was applied to the access to heights and bamboo scaffolding categories, respectively.

Baseline Scores

Table 1 represents the average baseline scores for each performance category. Average baseline scores represent the mean safety performance scores for the period prior to the introduction of behavior-based safety techniques in each category. Thus, with reference to Figure 1, the housekeeping baseline average includes data from weeks 1 to 18; the access to heights baseline average includes data from weeks 1 to 22; and the bamboo scaffolding baseline average includes data from weeks 1 to 26. Percentages relate to the percentage of safe activities and conditions observed.

Table 1 indicates that baseline performance in housekeeping was generally much better than baseline performance in access to heights or in

TABLE 1
AVERAGE SAFETY PERFORMANCE LEVELS OBSERVED DURING THE BASELINE PERIOD FOR
HOUSEKEEPING, ACCESS TO HEIGHTS, BAMBOO SCAFFOLDING AND PERSONAL PROTECTIVE EQUIPMENT
PERFORMANCE CATEGORIES

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7
Housekeeping	56.9%	73.4%	66.9%	63.5%	52.0%	50.9%	70.1%
Access to heights	26.4%	32.8%	49.7%	32.5%	31.1%	31.4%	27.4%
Bamboo scaffolding	59.4%	N/A	46.1%	33.6%	37.5%	40.7%	N/A
PPE	41.4%	51.0%	51.7%	49.0%	44.3%	46.5%	41.9%

bamboo scaffolding. On no site was average baseline performance in housekeeping less than 50% safe. On all seven sites the average baseline performance in access to heights was lower than 50% safe. Average baseline performance in bamboo scaffolding ranged from 34% to 59% safe.

Graphical Presentation of Results

The raw data for all performance categories from site 1 is displayed in Figure 2. This figure gives some indication as to the relative performance levels in each category. However, the figure itself is not very useful in determining the effectiveness of the intervention, as visual inspection of data is a notoriously unreliable method of assessing the significance of a change (Hartmann et al., 1980). The time-series impact analysis, described below, provides a much greater level of accuracy in assessing the effect of an intervention and is thus presented and discussed in greater detail than is any graphical presentation of data.

Statistical Analysis

Results were analyzed using Autoregressive-Integrated-Moving Averages modeling techniques. These techniques can account for peculiar characteristics inherent in time-series data. Failure to use statistical methods that are suited to time series data has undermined much of the behavior-based safety literature (Lingard, 1995). In only two of the behavioral studies found did researchers statistically account for the systematic error that often occurs in time series data (Komaki, Collins, & Penn, 1982; Chhokar & Wallin, 1984).

The application of standard statistical tests, such as *t*-tests and analyses of variance

(ANOVA), to time series data can, under certain commonly occurring conditions, produce results with a liberal bias. Such results are misleading and Hartmann et al., 1980 warn that the result of applying standard statistical tests to time series data is that "far too many interventions are found to be statistically significant when no real effect exists." Those behavioral safety studies that fail to account for the special characteristics of time series data in the statistical analysis of results must therefore be read and interpreted with great caution.

A method designed by Box and Tiao (1975), to assess the impact of an intervention in time series data was employed. The Trends module of the SPSS Inc. (1993) software package was used to carry out the analysis. Data from each category and from each site were examined for any change at the observations representing four identifiable points in the series. These were:

- The point at which goal setting and feedback were introduced in housekeeping;
- the point at which the housekeeping feedback charts were removed from each site;
- the point at which goal setting and feedback were introduced in the access to heights category; and
- the point at which goal setting and feedback were introduced in the bamboo scaffolding performance category.

In each analysis a *B*-value was calculated. *B*-values represent the overall change in performance occurring at a given point in the time series. Since safety scores represent the proportion of unsafe behaviors, a negative *B*-value indicates an improvement in safety performance and a positive *B*-value indicates a deterioration in safety performance.

FIGURE 2.
ALL DATA FROM SITE 1

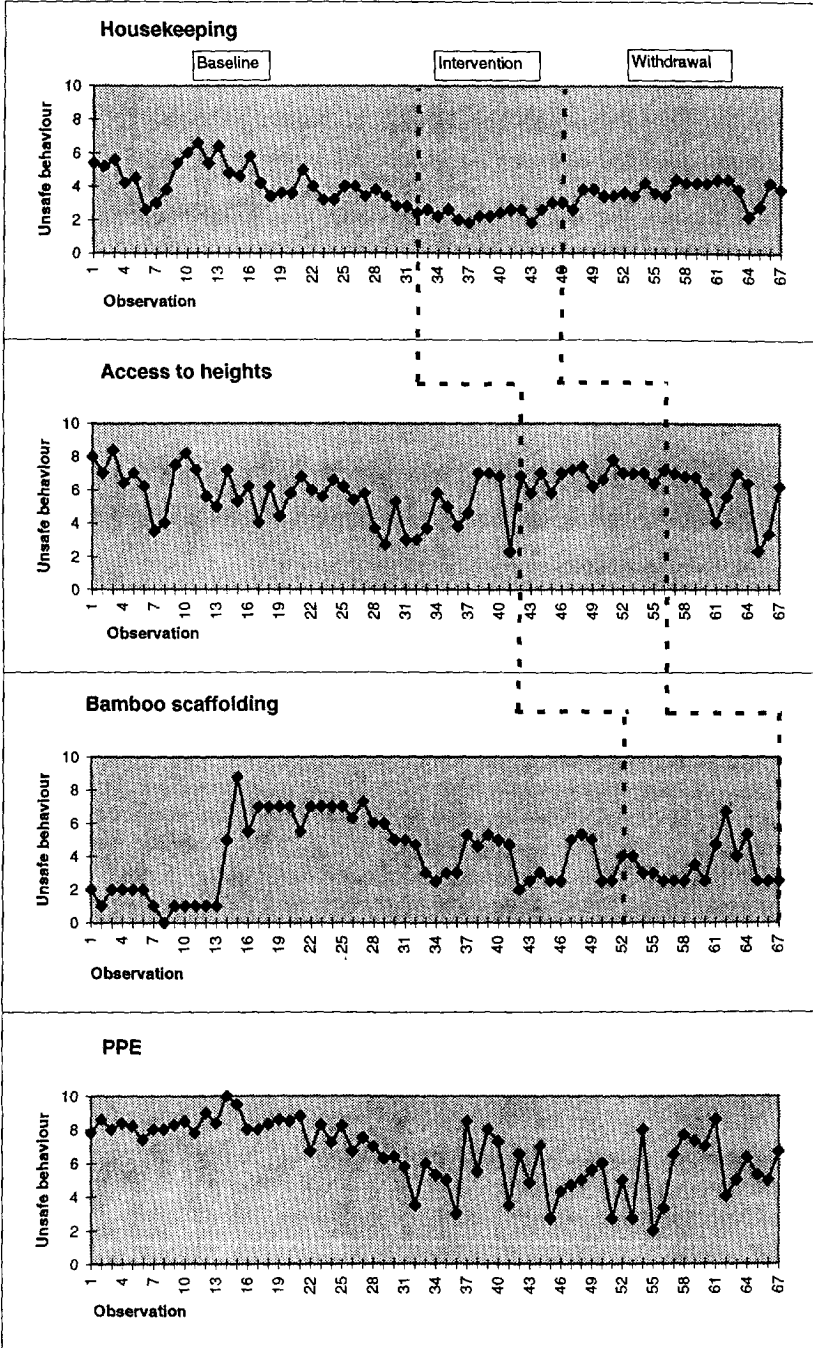


TABLE 2
HOUSEKEEPING PERFORMANCE RESULTS WHEN TESTED FOR A CHANGE WITH THE INTRODUCTION OF
GOAL SETTING AND FEEDBACK TO THE HOUSEKEEPING CATEGORY

Site	ARIMA model	Change	B-value	Overall change factor	Probability
1	(1,0,0)	Improvement	-1.500	150	0.003
2	(1,1,0)	Improvement	-0.139	13	0.788
4	(1,0,0)	Improvement	-1.300	130	0.000
5	(1,0,0)	Improvement	-1.990	199	0.000
6	(1,0,0)	Improvement	-2.190	219	0.000
7	(1,1,0)	Improvement	-0.138	13	0.808

RESULTS

The results of the impact analyses are presented below on a category by category basis. Information provided includes:

- The ARIMA model found to satisfactorily account for the systematic error in each time-series;
- the direction of observed change;
- the *B*-value generated in the impact analysis;
- the overall change factor associated with this *B*-value; and
- the probability of the *B*-value occurring purely by chance.

The overall change factor is the *B*-value multiplied by 10. This is sometimes interpreted as a percentage change (SPSS Inc, 1993). However this interpretation is probably an oversimplification of the statistical meaning of the *B*-value. McCleary and Hay (1980) describe ARIMA impact assessment models as "reflecting a change in level and/or (sometimes) trend for the generating process of the time series." They caution that a statistical concept rather than a substantive concept is implied and thus a *B*-value cannot be interpreted in absolute percentage terms.

Housekeeping

Table 2 shows the results of the impact analyses carried out to test for a change in housekeeping performance at the point at which goal setting and feedback were introduced in the housekeeping performance category.

A one-way ANOVA was applied to housekeeping data from Site 3, as no systematic error

was detected in this data. The analysis of variance indicated that Site 3's mean score in the housekeeping category was 3.303 (67% safe) during the baseline period. The mean score for housekeeping improved to 2.268 (77% safe) following the introduction of the housekeeping goal setting and feedback. An *F*-ratio of 14.131 ($p = 0.000$) indicates that this improvement was highly statistically significant.

Performance in housekeeping was found to improve on all seven sites, following the introduction of goal setting with feedback. On five of these sites (1, 3, 4, 5, and 6), this improvement was highly statistically significant.

The ability to draw causal inferences, under a multiple baseline research design, relies on the use of between category comparisons within the same subject (site). Thus the finding that a significant improvement in the control category (PPE) occurred with the introduction of the housekeeping intervention could be indicative of an "across the board" improvement in safety at this point. A general improvement could be unrelated to any intervention made and may indicate that the housekeeping intervention was not responsible for the observed improvement in housekeeping performance.

PPE scores from each site were tested for a change at the point at which the housekeeping intervention was introduced. The results of this assessment are presented in Table 3. While PPE performance improved on five of the seven sites, this improvement was generally not statistically significant. PPE performance deteriorated on sites 5 and 6, following the introduction of the housekeeping intervention. Furthermore, in contrast to the significant deterioration observed in housekeep-

TABLE 3
PPE PERFORMANCE RESULTS WHEN TESTED FOR A CHANGE WITH INTRODUCTION OF GOAL SETTING AND FEEDBACK TO THE HOUSEKEEPING CATEGORY

Site	ARIMA model	Change	B-value	Overall change factor	Probability
1	1,0,0	Improvement	-0.746	74	0.308
2	2,1,0	Improvement	-1.970	197	0.138
3	0,0,1	Improvement	-2.117	211	0.003
4	1,1,0	Improvement	-0.482	48	0.783
5	0,1,1	Deterioration	0.828	82	0.546
6	2,1,0	Deterioration	1.571	157	0.233
7	0,1,1	Improvement	0.962	96	0.265

ing performance following the withdrawal of performance feedback relating to housekeeping (see Withdrawal effect below), on no site was there a significant deterioration in PPE performance at this time.

Analysis of data relating to other performance categories (access to heights and bamboo scaffolding) indicated that on no site was there a general improvement of safety performance (i.e., improvement in all performance categories) when the housekeeping intervention was introduced. This finding lends weight to the argument that the improvement in housekeeping was due to the intervention.

Withdrawal Effect

Table 4 shows the results of the impact analyses

carried out to test for a change in housekeeping performance at the point at which the performance feedback charts were removed from the sites.

Site 3's mean housekeeping score following the removal of the housekeeping feedback chart was 72% safe. This represents a deterioration from the mean score during the intervention period (77% safe). A one-way ANOVA indicated that this difference was significant at a 0.05 probability level.

These results show that on all but one site, housekeeping performance deteriorated with the removal of the housekeeping feedback charts. On four of these sites (1, 3, 5, and 6), this deterioration was statistically significant. These findings further strengthen the argument that the observed improvements in housekeeping, when goal setting and feedback were introduced, can be attributed to the intervention.

TABLE 4
HOUSEKEEPING PERFORMANCE RESULTS WHEN TESTED FOR A CHANGE WITH THE REMOVAL OF PERFORMANCE FEEDBACK IN THE HOUSEKEEPING CATEGORY

Site	ARIMA model	Change	B-value	Overall change factor	Probability
1	(1,0,0)	Deterioration	1.215	122	0.000
2	(1,1,0)	Improvement	-0.044	4	0.906
4	(1,0,0)	Deterioration	0.167	17	0.117
5	(1,0,0)	Deterioration	0.479	47	0.008
6	(1,0,0)	Deterioration	1.007	101	0.000
7	(1,1,0)	Deterioration	0.180	18	0.635

TABLE 5
ACCESS TO HEIGHTS PERFORMANCE RESULTS WHEN TESTED FOR A CHANGE WITH THE INTRODUCTION
OF GOAL SETTING WITH PERFORMANCE FEEDBACK IN THE ACCESS TO HEIGHTS CATEGORY

Site	ARIMA model	Change	B-value	Overall change factor	Probability
1	(1,1,0)	Improvement	-3.001	300	0.027
2	(0,1,1)	Improvement	-2.240	224	0.036
3	(2,1,0)	Improvement	-1.535	154	0.340
4	(1,1,0)	Deterioration	3.778	378	0.000
5	(0,1,1)	Deterioration	0.268	27	0.764
6	(0,1,1)	Improvement	-0.503	50	0.588
7	(0,1,1)	Improvement	-0.555	55	0.456

Access to Heights

Table 5 shows the results of the impact analyses carried out to test for a change in access to heights performance at the point at which goal setting and feedback were introduced in the access to heights category.

As Table 5 indicates, the results of the access to heights intervention were mixed. Safety performance in access to heights was found to improve on five of the sites with the introduction of goal setting and feedback in this category, but on only two of the sites was the improvement found to be statistically significant (Sites 1 and 2).

On Site 4, there was found to be a highly significant deterioration in safety performance relating to access to heights at this time.

Bamboo Scaffolding

Owing to the fact that, by week 25 of the experiment, bamboo scaffolding was present on only four of the experimental sites, the bamboo

scaffolding intervention could only be introduced on these four sites. Table 6 shows the results of the impact analyses carried out to test for a change in performance relating to the use of bamboo scaffolding at the point at which goal setting and feedback were introduced in the bamboo scaffolding category.

As Table 6 indicates, no significant improvement in safety performance, relating to the use of bamboo scaffolding, was observed on any of the four sites at which goal setting and feedback were introduced in the bamboo scaffolding category.

DISCUSSION

The results indicate that behavior-based safety management techniques are not universally effective in bringing about improved safety performance in the Hong Kong construction context. The highly significant improvements in site housekeeping that occurred with the intro-

TABLE 6
BAMBOO SCAFFOLDING PERFORMANCE RESULTS WHEN TESTED FOR A CHANGE WITH THE
INTRODUCTION OF GOAL SETTING WITH PERFORMANCE FEEDBACK IN THE BAMBOO SCAFFOLDING
CATEGORY

Site	ARIMA model	Change	B-value	Overall change factor	Probability
1	(0,1,0)	Improvement	-0.021	2	0.988
3	(2,1,0)	Improvement	-0.492	49	0.561
5	(0,1,1)	Deterioration	0.909	90	0.274
6	(0,1,1)	Deterioration	0.092	9	0.907

duction of goal setting and feedback to this category, combined with the significant deterioration observed following the removal of housekeeping feedback, suggests that the behavior-based intervention was the cause of this improvement. However, the success of behavior-based safety techniques, when applied to site housekeeping performance was in marked contrast to the results achieved when the same techniques were applied to the access to heights and bamboo scaffolding categories. Possible reasons for these mixed results have been identified and are discussed below.

Management Commitment

Management commitment has been identified as a factor affecting the success of behavior-based safety programs (Duff et al., 1994). Six out of the seven project managers attended housekeeping goal-setting meetings, but no project managers attended meetings held to discuss access to heights or bamboo scaffolding. Worker perception regarding the commitment of senior management to the performance goals could have contributed to the effectiveness of the housekeeping intervention and the lack of success witnessed with respect to access to heights and bamboo scaffolding. Another factor contributing to this effect could be that initial enthusiasm for the behavior-based program was diminished by the time that access to heights and bamboo scaffolding goals were set.

Ability to Meet Goals

Housekeeping is a very different aspect of site safety to access to heights or bamboo scaffolding. Housekeeping is a highly visible aspect of safety to which everyone on site can contribute. Generally speaking, improvements in housekeeping can be made without the use of additional materials or equipment and without serious disruption to the work schedule. On the other hand, improvements in access to heights and bamboo scaffolding would require the deployment of extra resources, including materials, equipment, and considerable time.

At the access to heights and bamboo scaffolding goal-setting meetings, the view that compliance with the safety standards against which performance was being measured was impossible to achieve, was frequently expressed by both workers' representatives and

safety staff. Participative goal setting was implemented in all categories, including access to heights and bamboo scaffolding and it was emphasized that goals set should be realistic and attainable. However, despite the fact that safety staff and site workers were involved in the goal-setting process and, in some cases, engaged in heated discussion concerning the appropriate goal level, the final level was always decided by the most-senior site manager present. In all cases, this level was then agreed by all present. This may reflect the leadership style of Hong Kong construction managers and prevailing cultural norms. The results indicate that the intervention was effective in the housekeeping category despite this autocratic setting of goals by senior site management. However, in the categories of access to heights and bamboo scaffolding, it appears that senior site managers set goals that were impossible to achieve.

It was argued that it was not possible to fit guardrails and toeboards to the metal scaffold frames, commonly used by finishing workers and other trades on Hong Kong sites. Platform, guardrail and toeboard components are available as components of the scaffolding system in use, but these items are seldom observed on Hong Kong sites.

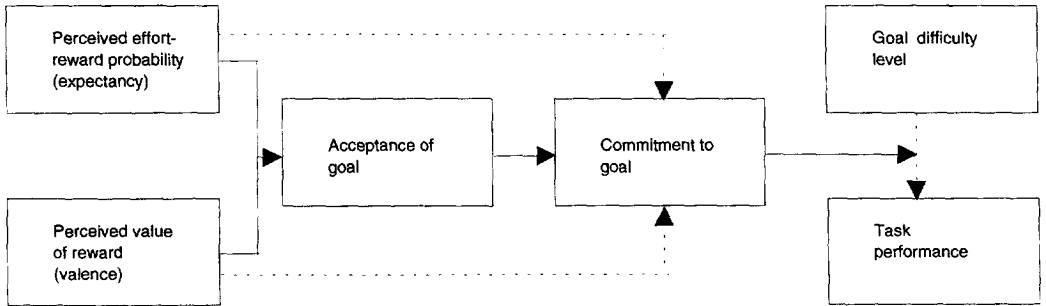
One site manager argued that cost constraints prevented the provision of closely boarded working platforms, guardrails, and toeboards on the external bamboo scaffold. The cost of these items had not been budgeted for in the bamboo scaffolding subcontract agreement and these items could therefore not be provided.

During an access to heights meeting, the researcher was told that workers must improvise and use "homemade" ladders on site as neither the main contractor nor the subcontractor provided them with ladders.

These arguments against the feasibility of taking basic safety measures, which, incidentally, are also required by Hong Kong legislation, suggest that it was not in the power of individual workers to behave safely with regard to access to heights or bamboo scaffolding. Under these circumstances, techniques aimed at improving worker motivation would certainly fail.

This finding is in accordance with an assertion by Bradley (1989) that the effects of goal setting and feedback safety interventions are often disappointing because the techniques are

Figure 3: A hypothetical model showing the effect of expectancy and valence on goal acceptance, commitment to goal attainment and task performance.



implemented in an environment that is otherwise unsupportive of safe performance.

Goal Rejection

Goal-setting theorists have stressed the importance of goal acceptance to the success of performance goal setting, but do not directly address the question of what factors may lead an individual to accept a goal and under what circumstances might an individual reject a goal.

Some authors have connected goal acceptance with Vroom's expectancy theory of motivation (Mento, Cartledge, & Locke, 1980). Under the expectancy model, an individual's behavior is determined by his/her beliefs in three areas. These are:

- The extent to which increased effort will lead to improved performance (expectancy);
- the extent to which improved performance will lead to a specified outcome (instrumentality); and
- the extent to which that outcome is valued by the individual (valence).

The higher an individual's belief that increased effort will lead to improved performance, the more strongly he/she perceives that performance will lead to an outcome, and the greater the value placed on that outcome, the more motivated that individual will be.

It is possible that an individual's perceptions in these three areas will initially determine whether a goal is accepted and, if the goal is accepted, will then determine the degree of extra effort the individual will exert in order to attain the goal (goal commitment).

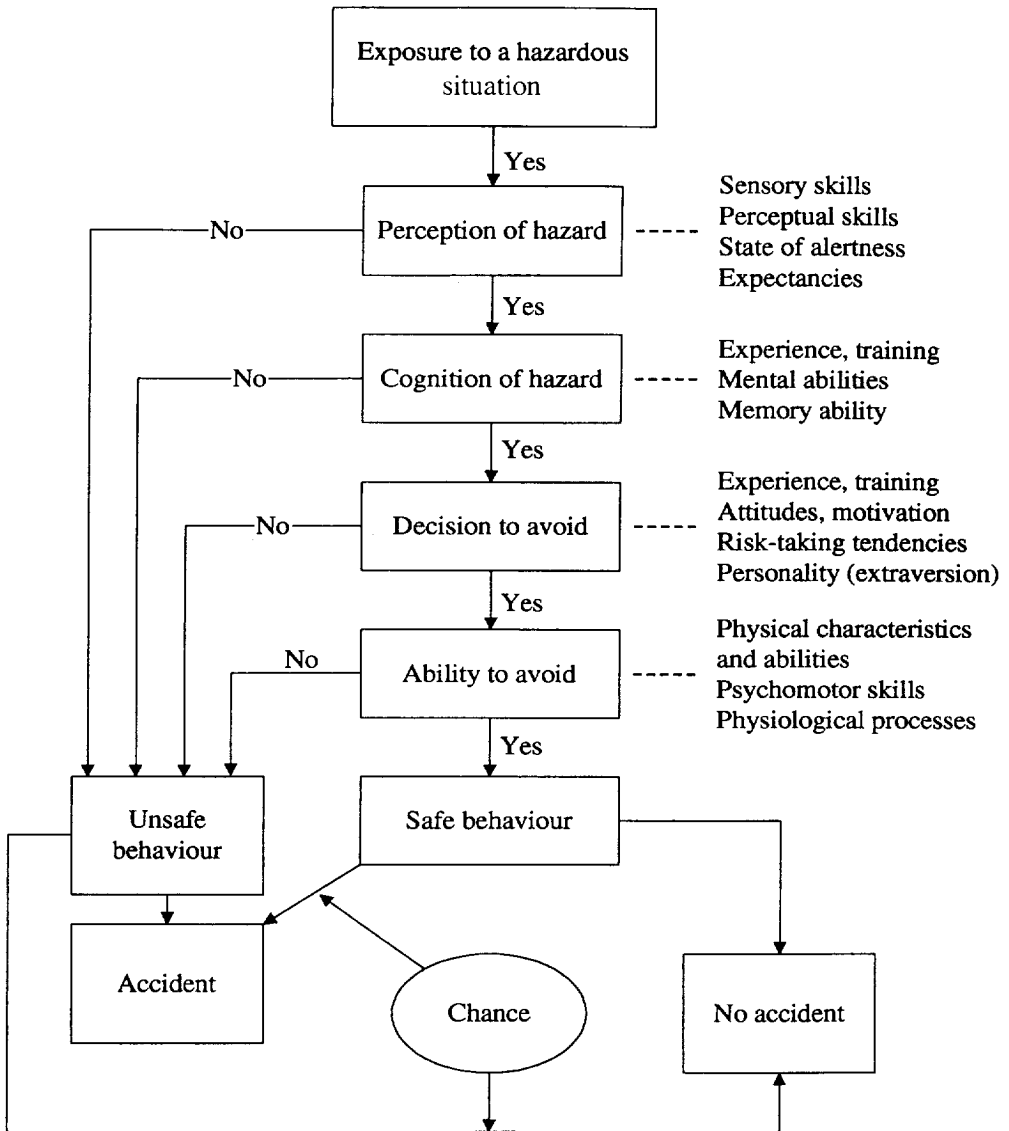
Figure 3 represents a theoretical model of this relationship.

It is possible that workers' perceptions that the access to heights and bamboo scaffolding goals were impossible to attain, or in terms of the model, their belief that the effort-reward probability was very low, led them to reject these goals from the outset. If this was the case then, as goal-setting theorists would expect, the techniques would not be successful in motivating workers to improve their performance. The validity of this model should be examined in future goal setting research.

Hazard Perception and Hazard Recognition

Behavior-based safety management techniques cannot work if workers are unable to perceive and recognize hazards at the workplace. A safety manager was here to express the view that falls from bamboo scaffolding were not a common problem in Hong Kong. Lingard (1995) points out that an analysis of Hong Kong Housing Authority data indicated that bamboo scaffolding is the most common location from which falls from height occur. This can be regarded as a failure in the safety management system. Data are available that show the hazard to be serious but, industry wide, management has failed to make this point clear. Furthermore, Furnham's (1994) hypothetical model (Figure 4) shows that failure to perceive and recognize hazards (Stages 1 and 2) leads to unsafe behavior. Behavior-based safety management attempts to influence workers at Stage 3, the "decision to avoid" a hazard. If there is no perception or recognition, then behavior-based techniques are bound to fail. Hence, there is an element of education needed in goal-setting meetings

Figure 4: Sequential model of accident occurrence
 Source: Furnham (1994)



that may help to fill the void left by inadequate prior training of workers.

Limitations of Behavior-Based Safety Management

There are some serious limitations to the effectiveness of behavior-based safety management.

The results of the field experiment illustrate these limitations. By definition, behavior-based safety programs focus attention solely on the role of the individual worker. Their effectiveness is limited because they ignore other, more fundamental, social and organizational factors that determine the industrial safety situation (Quinlan & Bohle, 1991).

The failure of the behavior-based safety interventions in access to heights and bamboo scaffolding categories reflect this limitation. The results, and the comments documented during the access to heights and bamboo scaffolding goal-setting meetings, suggest that the safety problems experienced by the Hong Kong construction industry are deeper and more complex than the commonly expressed problems of "worker attitude" or "worker carelessness."

Workers' failure to behave safely can, in certain circumstances, be regarded as a reasonable response to prevailing conditions. Unsafe behavior should be expected where unsafe, but speedy, construction work is financially rewarding, for both individual worker and contractors; or where adequate and appropriate materials or equipment are not provided to enable a task to be carried out safely.

The evidence suggests that, if behavior-based safety techniques are to be universally effective in Hong Kong's construction industry, attempts to change behavior must be preceded by changes in the way in which Hong Kong construction work is organized; a safety management system must be implemented.

SUMMARY

The results of a 9-month, controlled field experiment on public housing building sites in Hong Kong's construction industry indicated that the behavior-based safety management techniques of goal setting with performance feedback were not universally effective. Statistical analysis of the experiment results indicated that the techniques were highly effective when applied to the category of site housekeeping. However, when applied to the access to heights and to bamboo scaffolding performance categories, the techniques were generally unsuccessful in bringing about improved performance. The disappointing results in the latter two categories may be due to the fact that management appeared less committed to the safety program when the researcher introduced the techniques to these two categories. While senior site managers had attended the housekeeping goal-setting sessions, no project managers attended access to heights or bamboo scaffolding meetings. Comments made during the access to heights and bamboo scaffolding goal-setting meetings also indicated that there was a general

belief that goals could not be met in these two categories. Worker perception that goal attainment was not possible may even have led to the outright rejection of these goals. The results highlight a limitation of all behavior-based safety management programs in that worker behavior, although important, is only one factor affecting industrial safety performance and safe behavior can only be achieved where a basic safety infrastructure is already in place.

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