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A Validation Study for Comparison of Safety Climate Perceptions of Safe and Unsafe Workers

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A VALIDATION STUDY FOR COMPARISON OF SAFETY CLIMATE PERCEPTIONS OF SAFE AND UNSAFE WORKERS

by

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Abstract

A 50-item safety climate inventory based on a 40-item safety climate questionnaire proposed by Zohar (1980) was administered to 427 employees of ten industrial organizations in Illinois and Wisconsin. The ten extra items were added to Zohar's original questionnaire to explore two new dimensions; (1) workers perception of enforcement versus counseling, and (2) workers perception of social status. Zohar's 40 questionnaire items were extracted from the 50 item survey and a factor analysis was conducted which extracted 14 factors. A comparison was then made between this studies sample results and Zohar's original results on factor position and factor structure (i.e., item loadings). Similarities were discovered between factor structures, but not between factor positions.

A second factor analysis was then constructed using all 50-items, which again resulted in the extraction of 14 factors. Factor scores from each of these 14 factors were then submitted to a linear discriminant function analysis to assess the discrimination between accident versus accident-free groups. Results indicated that only two factors should be retained. These factors were worker perception of environmental risk and perception of management's attitude toward their well being. Analysis of mean factor scores for the two dimensions revealed differences between the accident and accident-free groups, with the accident group demonstrating a significantly lower level of risk perception and management attitude perception than the accident-free group.

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VITA

The author, Harold John Holmes, is the son of John Holmes and Hannah (Milcreek) Holmes. He was born August 22, 1925, in Floodwood, Minnesota.

His elementary and secondary education were completed at the Floodwood Elementary School and Lincoln High School respectively at Floodwood, Minnesota, where he graduated in 1943.

In August, 1943, he entered the Naval Aviation Cadet training program. As a Naval aviation cadet, he attended Monmouth College (Illinois), Loras College (Iowa) and the University of Iowa. He was commissioned as a Naval Aviator with the rank of Ensign in 1945. The U.S. Navy has credited him with a total of 15 years and 6 months of time in the reserve and active duty. He flew fighters and jets in the Navy.

In January, 1946, he entered the University of Minnesota. He received a Bachelor of Science degree in 1949 and a Masters Degree in Education in 1950.

He taught American Literature and grammar at Wayzata High School, Wayzata, Minnesota, in 1949-1950. From 1950-1956, he served as assistant professor of aviation and safety at South Dakota State University, Brookings, S.D. From 1960-64, as an adjunct instructor, he taught courses in Educational Psychology and Principles of Teaching to a special class of aviation instructors and educators. This was accomplished at Chicago Teachers College and later under the Mott Educational Foundation in Flint, Michigan (1963-65).

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CHAPTER I

INTRODUCTION

The purpose of this study was to distinguish through the utilization of confirmatory factor analysis discriminating variables and characteristics on which safe and unsafe workers are expected to differ. A unique aspect of the study was the random selection of a total of approximately 80 workers from each of eleven industrial organizations. The employees were selected from two groups of employees. Group I included 40 randomly selected workers who had experienced one or more work-related accidents within the past five-year period. Group II consisted of 40 workers who had worked "accident free" during the past five years of employment. A 50 item Zohar/Holmes safety climate attitude inventory using the Likert Scale, was provided to the employees of each organization, and the questionnaires were returned to the Safety Studies Department at the University of Wisconsin-Whitewater on a voluntary basis in a self addressed envelope. A total of 427 questionnaires were returned. Along with each questionnaire, a written statement was given to each worker in regard to the voluntariness and confidentiality of the information collected. A sample set of instructions was also included. (Appendix II)

A significant assumption of the study was that discriminating features characterize individual organizations and that the global perception of these features by production workers create the safety climate of the particular industrial plant. In other words, the perceptions employees have or share about their specific work environment make up the occupational safety climate. Several studies referred to in the literature review emphasize the importance of employee perceptions and expectations and the subsequent effect on employee behavior.

One of the most consistent findings in the reviewed literature was that in companies having successful safety programs, there was a strong management commitment to safety. This commitment was exhibited in a number of ways. Cohen, Smith, and Cohen (1975), Shafai-Sahrai (1971), and Zohar (1980), have all found that in low-accident companies, top management was personally involved in safety activities on a routine basis, whereas such commitment was conspicuously absent in high accident companies. It is clear that safety motivation has to flow from top management down to the person in the shop or on the assembly line. Although the worker is the focal point of any safety effort, is also necessary to give equal attention to motivate management so that it will accept, encourage, and initiate positive safety trends. An industrial organization, if it proposes to continue in business, must impress upon the employees that they are being cared for both on and off the job. However, on-the-job care in the form of safer and cleaner work places; in addition, to safer machines and tools is not always viewed with the same enthusiasm as contract benefits because the provision of these will not leave the worker any happier with management. In Frederick Herzberg's (1975) words safety is what the employee "expects" from management.

The complacency of management, however, can be reinforced with the institution of a safety department leading to the belief that safety has "been taken care of"; at any rate, the management is equipped with a made-to-order scapegoat. To justify his existence, the safety officer could, and is perhaps expected to, try his hand at motivating the work force, but it is not laid down as his job responsibility that he should keep motivating management. With the safety department doing its job, management assumes itself to be in the clear and able to pay full attention to production, investments, and returns on the one hand and bonuses, incentives, etc., on the other. This is the usual accepted procedure.

Organizational safety climate, as proposed in this study, could have both theoretical and applied significance. A major aspect of this study is to determine factors which could be used by employers to predict levels of safeness or unsafeness in the selection and assignment of employees to various tasks in the organization. The safety climate scores, when operationalized and validated, resulted in safety climate scores which had few similarities to Zohar's (1980) findings in Israel. This cross-cultural comparison became a secondary purpose of the research and the results are reported in the supplementary analysis.

Limitations of The Study

This study is limited to 427 employees of eleven industries and organizations in Illinois and Wisconsin. (See Appendix I). The sample, instrument and method in the study are described in Chapter III.

Organization of The Study

The remainder of the dissertation is organized into four chapters. The review of the literature related to safety climate as defined by the perceptions employees have or share about their specific work environment is presented in Chapter II. A review of educational and psychological research relevant to facilitating behavior change to improve safety climate is also presented.

Chapter III presents the methodology, including a description of the sample, the variables selected for the study, and the scales used to measure these variables.

Chapter IV presents the results and includes a description of the statistical procedures used to test the hypotheses and the findings based on these tests.

A summary of the results of the study and recommendations for further research are presented in Chapter V.

CHAPTER II

REVIEW OF THE LITERATURE

The literature reviewed in this chapter is divided into two basic sections. Literature related to organizational climate is presented in the first section. A clear distinction is made between organizational climate and organizational safety climate. Organizational climate is based on structural properties; whereas, organizational safety climate deals with perceptions held by employees.

Literature concerning various educational and psychological theories and their assumptions concerning behavior change is presented as it relates to safety climate.

Organizational Climate

Writers of organizational climate distinguish between specific climate measures, such as a climate scale (House and Rizzo, 1972) and holistic climate measures. Examples for such holistic climates are motivational climate (Litwin and Stringer, 1968), individual differences climate (Schneider and Bartlett, 1970) and creativity climate (Taylor, 1972). According to climate theories, any organization creates a number of different climates and the term organizational climate has to be supplemented by an appropriate adjective indicating which type of climate is being addressed. Schneider (1975) proposes that the term "organizational climate" should describe an area of research, rather than a specific organizational measure. It is on this basis that the term "organizational safety climate" was developed. In contrast, measures of organizational climate are based on certain structural properties of organizations such as (1) size, structure, system complexity, leadership style, and goal directions (Forehand & Gilmer; Porter & Lawler, 1964); and (2) perceptions held by employees (Schneider, 1973; Sells, 1968; Tagiuri, 1968).

Organization Safety Climate

This study has adopted the second interpretation of organizational climate; namely; climate as viewed as a summary of molar perceptions that safe and unsafe workers share about their respective work environments. Based on a variety of cues present in their work environment, employees develop coherent sets of perceptions and expectations and behave accordingly (Dieterly & Schneider, 1974; Fleishman, 1953; Litwin & Stringer, 1968). These coherent sets of organization perceptions, when shared as summarized for individual employees, are defined in this study as organizational safety climates.

The basic assumptions that are associated with organizational climate are related to Gestalt theory and functionalism theory. They are:

1. Humans tend to apprehend order in their enviornment and to create order through thought.
2. As humans participate in the work environment they need to adapt their behavior to different working conditions.

Gestalt theory is concerned with perceiver tasks. This theory maintains that an individual attempts to apprehend the order of that which objectively exists in the world and through no choice of his/her own creates new order by a process of integration through thought. A person builds a total concept of order based on a set of cues. Cues are the outside stimuli that influence the perception.

Functionalism theory is concerned with the process of behavior and how behavior serves to help the organism adjust to environments. This concept can be broken into two basic components; the functions of cognitive and behavior in adaptation, and the role of individual differences in the capacity to adapt. In this case order is perceived in order to adapt to the environment.

Dimensions of Safety Climate

In order to determine the various dimensions of safety climate, the review of related safety literature proved to be helpful. The primary purpose of this review was to define organizational characteristics that differentiate between high versus low accident-rate companies. It was assumed that such organizational features characterize individual industries and the global perception of these by industrial employees, therefore, form the safety climate of that industry.

One of the most consistent findings in the review of literature was that in industries having successful accident prevention programs, there was a strong management commitment to safety. This commitment was exhibited in a variety of ways. Cohen, Smith, and Cohen (1975), Mobley (Note 1) and Shafai-Sahrai (1971) have found that in low-accident companies, top management was personally involved in safety activities on a routine basis, whereas such commitment was conspicuously absent in high-accident companies. Cleveland, Cohen, Smith, and Cohen (1978) and

Shafai-Sahrai (1971) have reported that in low-accident companies safety matters were given high priority in company meetings and production scheduling, based on the conviction that safety is an integral part of production systems and accidents are actually symptoms of design faults in that system.

Another expression of management commitment found to discriminate between companies was the rank and status of safety officers; hence, in the companies with better safety records they had a higher status. This finding was reported by the Accident Prevention Advisory Unit in the United Kingdom (1976), Cohen et al. (1975), Davis and Stahl (1964), and Planek, Driessen, and Vilardo (1967). A second highly consistent organizational characteristic discriminating between companies was emphasis put on safety training. In companies with low accident rates, safety training was designed as an integral part of new workers' training (Cohen, et al., 1975; National Safety Council, 1969; Mobley), or as a follow-up and periodic retraining for workers and supervisors (Davis & Stahl, 1964; Planek et al., 1967). A third characteristic was the existence of open communication links and frequent contacts between workers and management (Accident Prevention Advisory United in U.K., 1976; Cohen et al., 1975). Another expression of this free flow of information was found to be the carrying out of frequent safety inspections by appropriate personnel (Davis & Stahl, 1964; Planek et al., 1967). General environmental control and good housekeeping was the fourth characteristic appearing consistently. Orderly plant operations, controlled environmental conditions, and high usage of safety devices comprised this organizational characteristic in low-accident companies

(Shafai-Sahrai, 1971; Smith, Cohen, Cohen, & Cleveland, 1975).

A fifth characteristic was a stable work force with less turnover of older workers (Cleveland et al., 1978; Cohen et al., 1975; David & Stahl, 1964). Although not specifically studied, this factor probably reflected better industrial relations and elaborate personnel development practices in these factories. Finally, successful companies had distinctive ways of promoting safety. These included guidance and counseling, rather than enforcement and admonition. In addition, it included individual praise or recognition for safe performance and enlisting workers' families in safety promotions (Cleveland et al., 1978; David & Stahl, 1964; National Safety Council, 1969).

When all these organizational characteristics are integrated, it is possible to form a coherent organizational pattern of a highly safe company: Management is actively involved in safety management and creates a general administrative control climate (Grimaldi, 1970) in which work is to be performed. Grimaldi reports that climate results in increased performance reliability of workers, good housekeeping, and high design and maintenance standards for work environments (Grimaldi, 1970). There are well-developed personnel-selection training and development programs in which safe conduct is an integral part. Communication links between workers and management are kept open, enabling a flow of information regarding production as well as safety matters. Finally, general management philosophy is not strictly production oriented but also people oriented, as evidenced by various supportive policies described above. All the organizational characteristics described above were corroborated in a comprehensive review article published by Cohen (1977).

Based on the review literature, it was decided that Zohar's safety climate questionnaire results contained the following dimensions. This present study was designed to measure the following characteristics: (a) perceived management attitudes towards safety, (b) perceived effects of safe conduct on promotion, (c) perceived effects of safe conduct on social status, (d) perceived organizational status of safety officer, (e) perceived importance and effectiveness of safety training, (f) perceived risk level at work place, and (g) perceived effectiveness of enforcement versus guidance in promoting safety. The above perceptions are substantiated by Zohar's study except for dimension (g) which included those organizational characteristics found to discriminate between high versus low accident rate companies on the basis of enforcement measures versus guidance in changing worker behavior.

PROGRAM DEVELOPMENT FOR BEHAVIOR CHANGE TO IMPROVE SAFETY CLIMATE

Most safety professionals will admit they could benefit from education in motivational techniques. Krathwal and Bloom (1964), in their taxonomy of human learning, identified three main domains or classifications which are significant for effective safety programs to effect change needed for controlling accident potential:

(a) COGNITIVE - learning objectives which usually require the individual to solve an intellectual task by identifying the problem and applying previously learned solutions.

(b) PSYCHOMOTOR - learning objectives which emphasize motor skills; these are often found in trade and technical levels.

(c) AFFECTIVE - learning objectives which produce emotional feelings and values in the learner about selected phenomena (Krathwal et al., 1964).

Some safety training programs need to be criticized as barely going beyond a skill acquisition/response situations similiar to the Pavlovian model of behavior. In fact, much safety "training" (as distinguished from safety "education") is directed at a psychomotor level of learning with very little accent given to the awareness properties of cognitive domain (Krathwal et al., 1964). It is proposed that a greater blending of cognitive and psychomotor learning of industrial safety measures would lead to a reduction in accidents, especially those caused by unsafe acts of workers. Workers would be more interested in such an approach and they would obtain more satisfaction.

This researcher theorized that moving from the behavioristic model to the cognitive and psychomotor domains, could do much to involve and motivate workers internally. Problem solving, creativeness and humanistic influences would prevail. A departure from the Pavlovian model, prevelant in industry today, would help implement programs to change worker behavior based on internal beliefs, emotions, cues and attitudes about the safety environment.

Management, of course, would not only be exposed to cognitive and psychomotor learning of safety education, but also the affect and humanistic domains would be introduced in order to change attitudes throughout an organization, starting at the top of the hierarchial command with changed attitudes emanating through lower levels of the hierarchy (Cohen, 1975).

Humanistic Approaches

Humanistic education includes a variety of teaching methods and approaches such as counseling employees to improve attitudes, special kinds of group exercises, and role playing. The basic objectives of humanistic approaches are easy to support. The most important outcome of humanistic approaches is a belief that the employee in industry should take more responsibility for determining what is to be achieved and become more self-directing and independent. Using humanistic methods in industrial training programs would enable employees to become self-actualized persons as described by Maslow (1968). The creativity of the self-actualized person, inherent in everyone, supposedly requires no special talents or abilities. It merely requires the right environment for its development and support. It shows up when in everyday life people are perceptive, spontaneous, expressive, genuine, joyful and unafraid. Only a special kind of freedom can produce such a person (Gage, 1975). Rogers and Dymond (1954) presented evidence that a certain therapeutic procedure produced a person who came to see himself differently -- to accept himself, his feelings, and other persons more fully. He became self-directing, confident, mature, realistic about his/her goals (Gage and Berliner, 1979, p. 560).

Certainly, Maslow's prepotency needs can be applied to this study. Higher needs of workers cannot emerge until lower ones such as safety and job security have first been satisfied. Maslow's theory can be a significant factor in improving and moving the organization safety climate to a higher level. Maslow's prepotency theory has been used in this study to make comparisons between Israeli worker attitudes and attitudes of U.S. workers on the basis of Maslow's needs hierarchy.

Hawthorne Effect

The humanistic movement includes industrialists hoping to maximize productivity. An experiment at the Western Electric Company's plant in Chicago almost unintentionally provided significant information on the impact of human relations on the productivity in an organization. Findings of this study (Roethlisberger and Dickens, 1939) indicated that the social aspect of an industrial plant is more important to the individual than its productive organization. It also demonstrated that satisfying adjustments in the social and emotional realm play a much more significant role in industrial production than alterations in wages and hours. Out of this exhaustive humanistic research came one outstanding recommendation -- the establishment of a counseling program to assist workers in solving personal problems. Such a program has been organized, with one counselor for each 300 employees. One significance of this outcome is that it indicates that for the industrial concern which desires maximum production, maximum harmony in industrial relationships, and maximum development for the individual worker, counseling is a process of the utmost importance (Rogers, 1942).

The humanistic experiment is credited with changing the organizational style of employers to place less emphasis on the rigid interpretation of efficiency and greater attention on obtaining the cooperation of employees and helping them identify more closely with the organization and its goals. The term "Hawthorne effect" grew out of the experiments as well. Those who believe it exists interpret the Hawthorne effect as producing a positive change in behavior, learning, or output simply through knowledge of participation in an experiment. The gain stems from demonstrated concern for the needs of the worker and the special attention accorded him during the study (Knezevich, 1975, p. 78).

In summary, the basic assumptions underlying humanistic approaches to industrial accident prevention programs lead to the following implications:

1. Employees should be allowed to determine their own needs and methods to a much greater degree than is customary.
2. Employees need to be encouraged to evaluate themselves in relation to efficiency, productivity and safety perhaps more than they need evaluations by others, such as supervisors.
3. Communication, understanding and coping with feelings of others is just as important as learning facts, intellectual and psychomotor skills.
4. Working and existing are best done in an atmosphere free of threat, pressure, competition, externally imposed standards common in most industrial settings.

In an industrial setting these basic assumptions can be applied and evaluated by management. Methods for achieving these assumptions will require management personnel to allow workers an increased amount of freedom in decision making and participative goal setting. Management by objectives (MBO) and the Japanese "Quality Circle" systems lend themselves to these types of humanistic approaches. The future selection of high quality employees by industry will also be an important factor in implementing the above basic assumptions.

Industrial training programs can foster this kind of training atmosphere if the instructor is a genuine, open, and secure human being with essentially warm and favorable feeling about other persons in general. Such industrial trainers know how to empathize with others, that is, to put themselves in another person's place and to understand the feelings and needs of employees in training programs. Instructors need to work with trainees rather than to consider them as lower class citizens. Industrial managers work with and through people to accomplish the purposes of the organization. Sensitivity to the human factor is an important first step. How to motivate employees and their peers to be safer on the job is an important need. Management must be concerned with what makes people behave as they do. The search for understanding whether it is external motivators or internal motivators that drive people to do what they do is a complex one. The motivation strategies employed will depend in part on how the employer views the people with whom he works. In other words (Barnard, 1938), what the manager believes to be fundamental human nature influences his choice of rewards and punishments as well as administrative style.

In present day industrial settings management philosophy will influence administrative style. Industries with democratic (open systems) philosophical management will involve employee participation in decision making including choices of rewards and punishments. The more traditional or autocratic type management system will not be as flexible and employees will have more restrictions in decision making and employee participation. The autocratic manager will maintain tight control of the safety program.

Humanists believe that the individual has the capacity to be virtually self-motivated and self-controlled. Cooperative social relations are natural to man, according to the humanistic theory. A worker has the propensity to become psychologically involved in corporate activity including safety programs. Equally important is the concept that a person's reaction to life is influenced most by the way he is treated by others. The humanistic executive considers work just as natural as play. The worker strives to establish cooperative social relations, do not enjoy being loners, are basically self-controlled, and naturally creative and strive for excellence in everything they do including safety activities.

> Under proper conditions most individuals will seek greater responsibilities and use much of their imagination, ingenuity and creativity in solving company problems. The employer who holds these views of his fellow workers will design and organization structure and use an administrative style that will place more reliance on self-control than on external supervision. Utilizing this type of approach in safety will give workers greater freedom to act, and will emphasize recognition for achievement to motivate rather than fear of punishment of enforcement of strict safety rules and regulations (Rogers, 1942).

Management-by-objectives-and-results (MBO/R) is an approach to administration that is concerned with motivation of employees among other things. It is a participative management style in which employees are motivated by an opportunity to work toward meaningful safety goals which workers helped to define (Knezevich, 1975). Employees safety behavior will be affected in industries where participative management prevails. Motivation to achieve both company and personal safety goals will be high. Observations of companies utilizing participative management indicates that employee teamwork to achieve safety goals appears to be more successful in companies using participative "open" systems styles of management. These same organizations have been able to create "peer" pressure by employees which has been highly beneficial in achieving a "ZERO" accident rate.

Maslow (1968) attempted to explain human behavior on the basic hierarchy of needs. The basic physiological needs of hunger and thirst usually are placed at the bottom of the hierarchy. Assuming physiological cravings are satisfied, motivation of human behavior moves up the scale toward safety needs, need for social affection, need for self esteem, need to understand, aesthetic needs, and need for self-actualization which is highest in the hierarchy. A satisfied need no longer motivates. It is difficult to stimulate a person to pursue a higher need such as self-actualization if a more basic need such as hunger is not satisfied (Maslow, 1968).

Safety administrators are concerned with human resources which are considered assets without which a company could not achieve its potential. Recognition of human beings as assets that require further development to enhance company growth is a logical outcome of the humanistic approach. Maslow's theory of human behavior on the basis of hierarchy can be a significant factor to improving and developing corporation safety programs.

It is theorized that Maslow's hierarchy of needs can be utilized by an industry initially to evaluate individual workers and/or groups of workers. Proposed evaluations would be based on the levels workers had presumed to have reached in Maslow's hierarchy of needs. Although safety needs are just one level above the lowest level--physiological needs--it is the higher level needs such as self-esteem and self-actualization that contribute to developing proper safety attitudes. Safety theorists have labelled safety climate as an individual perception affecting safety attitude. Experience proves that worker attitudes are instrumental in developing an individual's safety behavior. Maslow's theory portends this type of philosophy.

Safety Training

All accident-prevention work, whether or not it is educationally intended, is nevertheless educational in its effect upon the individual employee whom it necessarily involves (Heinrich and Peterson, 1980, p. 277). That this is true is clearly indicated by evidence that the well-trained and careful workers may avoid injury on dangerous work and that untrained and inexperienced workers may be injured even under the safest possible conditions. Research by the National Institute on Safety and Health (NIOSH) indicates that trained workers in the roofing industry have significantly lower accident experience than do untrained and/or newly hired workers. The roofing industry has one of the highest accident frequency rates within the construction industry. In construction (roofing) jobs the untrained person could experience a much higher level of risk from an accident standpoint than the trained worker. This is due to the high exposure rate to many different hazards related to the job of roofing.

Those persons with the responsibility for industrial training programs need to understand the basic principles and processes of learning and teaching if they are to attain professional competence. The proper education of the employee in accident prevention methods and procedures is paramount in industry today. Most industries invest much time and resources in training programs, therefore, a professional trainer or instructor must be a master of many skills and fields of knowledge including learning concepts. Also, much can be gained by applying principles of educational psychology to the development or improvement of occupational training programs.

What is taught certainly demands technical competence in the areas of industrial skills and knowledge, but the way in which the teaching is accomplished depends largely on the instructor's understanding of how people learn and their ability to apply that understanding. This part of the review of literature can be viewed as a study of applied educational psychology, for the subject underlines virtually everything with which the trainer or instructor needs to be concerned.

EDUCATIONAL AND PSYCHOLOGICAL THEORIES RELATED TO BEHAVIOR CHANGE

Motivational Techniques

Most safety professionals will admit they could benefit from education in motivational techniques. There appear to be four main classifications which are significant for improving safety programs and in controlling accident potential; namely, cognitive, psychomotor, affective and humanistic concepts. These four domains are included in this study. Safety training programs have been criticized for barely going beyond stimulus/response concepts similiar to the Pavlovian model of behavior.

THE LEARNING PROCESS

Definition of Learning

> The ability to learn is one of humanity's most outstanding characteristics. Learning occurs continuously throughout a person's lifetime. To define learning, it is necessary to analyze what happens to the individual. Learning theorists generally agree that individuals will learn most efficiently if they are motivated toward some goal which is attainable by learning the subject matter presented (Heinrich and Peterson, 1980, p. 283).

As a result of a learning experience, an individual's way of perceiving, thinking, feeling, and doing may change. Thus learning can be defined as a change in behavior as a result of experience. The behavior can be physical and overt, or it can be intellectual or attitudinal (Hilgard and Bower, 1975, p. 17), not easily seen. A peculiar but nonetheless functional definition of learning is the following:

> Learning refers to the change in the subject's behavior to a given situation brought about by his repeated experiences in that situation, provided that the behavior change cannot be explained on the basis of native response tendencies, maturation (Hilgard and Bower, 1975), or temporary states of the subject (e.g., fatigue, drugs, alcohol, etc.).

The definition has the import of allowing an inference regarding "learning" only when a case cannot be made for another explanation. It does not state sufficient conditions for learning, since some cases of repeated experience with a situation do not produce much in the way of observable changes in human behavior.

Application of Learning to Occupational Safety Training Programs

In conducting training courses for supervisors in industry, some may ascertain that they may have more important production problems to worry about and will spend training time thinking about them and complaining about being taken away from the job to learn a lot of nonsense. Or they may enjoy the opportunity to get together with the "gang" and swap stories. Still others may see the training class as an opportunity to show how much they know and to strive for greater recognition in the eyes of the trainer and their fellow employees. A few may see that new learning may aid them in their job. The behavior of people is oriented toward relevant learning goals, whether these goals are safety, increased recognition, production, or simply socialization. People attempt to achieve those goals which are salient at the moment, regardless of the trainer's intent (Heinrich and Peterson, 1980, p. 286).

The person training workers has the challenge and responsibility to develop learning objectives (goals) which can be fulfilled by everyone in a training progrm. Regardless of the individual differences involved, the training director, who has prepared an excellent safety training program based on clear-cut learning objectives, can evaluate the results based on the achievement of objectives while progressing through each training session.

Learning is a major consideration in safety programs. In order to change attitudes, one must substitute new learning for old concepts and ideas. To change behavior in need satisfaction sequences, one must teach using the best methods possible to achieve the training objectives.

In shop practice, safety education is not specifically defined. Ordinarily it refers to meetings and talks, personal contacts with authorities or teachers, the use of bulletins and posters or other reading matter, sound slides and motion pictures, and first-aid instruction. Oral or written instruction in avoiding hazards and cultivating safe methods of doing work is also a part of the learning processes.

In industry, specific safety training among employees is largely a task for supervisors and foreman. By virtue of their authority and close daily contact, supervisors are in a position to convert safety learning concepts to everyday safe practice procedures that apply to individual tasks, machines, tools, and process.

Not only should employees be taught that safety is worthwhile, but that it is their duty to themselves, their families, the community, and to their employers to avoid injury. They need to learn about specific dangers to be guarded against in their own line of work and what specific things they, themselves, may do to avoid injury. Most employees are uninformed about the hazards which exist in most jobs and as a result, they need to be trained. Safety education is primarily the process of imparting knowledge of safe and unsafe mechanical conditions, safe and unsafe personal practices, and remedial measures.

CHARACTERISTICS OF LEARNING

Individual Differences

Each industrial trainee approaches a learning situation from a different viewpoint. Each person is a unique individual whose past experience affects readiness to learn and understanding of the requirements involved. For example, an industrial trainer may provide two maintenance technicians the assignment of learning certain inspection procedures. One student may thoroughly learn and be able to competently present the assigned material. Because of job background and future goals, that trainee realizes the value of, and the need for, learning and procedures. A second worker's goal may be to merely comply with the instructor's assignment and, therefore, this person may complete only minimum preparation. The responses differ because each person acts in accordance with the requirements seen in a particular situation.

Individual Goals

Most people have fairly definite ideas about what they want to do and achieve. Their goals sometimes are short term, a matter of days or weeks. Each trainee has specific goals and objectives. These goals may be carefully planned for a career or a lifetime. Studies show that individuals learn from any activity that tends to further their purposes and that affective and humanistic education concepts play a role (Holmes, 1976).

CONNECTIONIST LEARNING THEORY

Stimulus Response Learning

In occupational training programs the currently important theories of learning can be classified in a number of ways. For our purposes, one difference is particularly outstanding, the difference between the connectionist (psychomotor) and the cognitive theories. Connectionist interpretations of learning tend to share the assumption that learning is a matter of connections between stimuli and responses (Hill, 1977, p. 26). This is also known as respondent learning where a response is elicited by known stimulus. Connectionist theorists typically assume that all responses are elicited by stimuli (Hill, 1977). These connections are called by a variety of names, such as habits, stimulus-responses bonds, and conditioned responses. Research in this area examines responses that occur, the stimuli that elicit them, and the ways that experience changes these relationships between stimuli and responses. Some of the best examples of respondent learning are the classical conditioning experiments performed by Ivan Pavlov.

Connectionist Interpretations to Industrial Training

Most learning theorists agree that learning involves some type of stimulus and a response. An example of stimulus response in driving is when a driver enters a skid with a heavy load, the skid is the stimulus and the immediate response is to recover. The feeling of safety when recovery is complete is the reward.

Association

The factor of association is involved in the example relating to the driving experience. The individual associates the skid possibly with some fear. Through the experience of a successful recovery from the skid, the driver has learned by doing. This later aspect, learning by doing and building on past experience, is a phenomenon used often in teaching occupational type skills such as driving or operating a crane.

Trial and Error Learning

Another type of learning process which is commonly used in occupational training is that of learning by trial and error. Trial and error learning is generally considered to be inefficient in that much time is often lost attempting to find the correct solution to a problem. However, when direction and guidance are provided in trial and error learning, the process can be effective. As an example, the instructor might explain driving up a steep incline with a load. The student's first attempt would be partially unsuccessful. The student has made a trial and an error has resulted because of his lack of coordination between the clutch and accelerator. Instead of permitting the trainee to continue trying first one method and then another, the instructor can intercede and explain to the trainee the source of difficulty. With this added information, the student can try again. This process is continued with the instructor pointing out the correct and incorrect technique until success is finally achieved.

Habit Formation

A habit is a learned stimulus-response sequence. When teaching a worker to use a piece of industrial machinery (Kaplan, 1964), the instructor is attempting to implant new habits. This is one of the purposes for having the trainee practice each new skill until its execution becomes automatic. Practice strengthens the habits and makes the learner less likely to forget (See Appendix X). The instructor should explain the interrelation of new habits to those already learned. This occurs through association.

Psychomotor Learning

In learning a physical (psychomotor) skill such as driving a forklift truck, the learning of a physical skill requires actual experiences in performing that skill. Operators of forklift trucks learn to drive only if their experiences include driving them. Apprentice maintenance technicians learn to overhaul powerplants only by actually performing the task. When discussing simple reactions of more complex physical skills, we are likely to say, "I guess it's just a bad habit I've learned," or with all that practice," his reactions have become fast and smooth." Mental habits are also learned through practice. However, if trainers see their objective as being only to train their student's memory and muscles, they underestimate the potential of the total training situation.

COGNITIVE LEARNING THEORY

Cognitive interpretations are concerned with the cognitions (perceptions, attitudes or beliefs) that individuals have about their environment, and with the ways these cognitions determine behavior. In these interpretations, learning is the study of the ways in which cognitions are modified by experience (Hill, 1977, p. 211). When discussing matters that involve words or deliberate decisions, we often say things like, "He has acquired a lot of knowledge on safe practices," or "You'll have to learn that employees don't like to be treated that way," or "Now I really understand how to do a job safety analysis!"

These interpretations are all cognitive which involve inner feelings.

Piaget's Theory of Intelligence

Piaget's theory of intelligence posited equilibration as a mechanism of development. Equilibration is a progressive, self-regulating process which leads step by step to a final state of reversibility that characterizes higher cognitive structures. Once a person's thought includes the concept of transformation, he is prepared for the next stage in learning. This preparation consists in an increased probability that the next stage will soon be reached (Hilgard and Bower, 1975, p. 322).

Concepts of Assimilation and Accommodation

Two important processes involved in equilibration are assimilation and accommodation. According to Piaget, assimilation involves knowledge derived from the environment and depends on prior experiences producing a background into which the new environmental experience fits. Assimiliation is the process of "fitting in" new knowledge which then becomes part of existing cognitive organization, e.g., interpretation of new experiences in terms of an existing schema. Accommodation, in contrast, involves the changing of schemes or structures so as to conform to the new experience, e.g., a change in a schema to incorporate new experiences.

Stages of Cognitive Development

In studying the process of accommodation, we can see that a person's knowledge structure is constantly changing throughout life.

Piaget has described these changes in cognitive development as follows: sensory-motor (birth to 2), preoperational (2 to 7), concrete operations (7 to 11) and formal operations (11 to adulthood).

Piaget also mentions "conservation" which refers to the fact that some quantitative property of matter remains the same in spite of changes in other properties. The mastery of various forms of conservation takes place at somewhat different ages.

Cognitive Interpretations in Industrial Training

Psychologists sometimes classify learning by types: verbal, problem solving, insightful, emotional, perceptual, and conceptual. All of these could be concerned with the cognitions that individuals have about their environment. These cognitions can be modifed by experience. For example, an industrial safety class learning to apply the scientific method of problem solving may learn the method by trying to solve real problems. But in doing so, it also engages in verbal learning and sensory perception at the same time. Each student approaches the task with preconceived ideas and feelings, and for many students these ideas change as a result of experience. Previous experience conditions one to respond to some things and to ignore others (FAA, Aviation Instructor's Handbook AC 60-14, 1977).

Individuals do not soak up knowledge like a sponge absorbs water. The instructor cannot assume that students remember something just because they were present in the classroom, shop, or loading dock when the instructor "taught" it. Neither can the instructor assume that the students can apply what they know because they can quote the correct answer from the book. For learning to occur, individuals must react and respond, perhaps outwardly, perhaps only inwardly, emotionally, or intellectually. But if learning is a process of changing behavior, clearly that process must be an active one and the way in which various cognitions (perceptions, attitudes, insights emotions and beliefs) determine behavior. Learning, then, is the study of the ways in which cognitions are modified by experience.

Insightful Learning

Insightful learning is a cognitive process. Insight is a learning process by which the person assembles from his present knowledge the ideas, concepts and facts which he/she uses to arrive at the answer to a new problem or a problem that is similar to problems previously experienced. Insight is usually considered to be a relatively sudden realization of the correct solution to a problem (Kaplan, 1964). How the student acquires insight and understanding (ability to make correct responses to problems) is the special concern of cognitive theorists of the learning process (Gage and Berliner, 1979, p. 272).

Insightful learning might be compared to the meshing of gears in an automobile transmission. Although controlled automatically in many cars today, the gears must mesh before the car may move. The spinning gears, which when properly meshed in the transmission cause the car to move, could be compared to the human mind. In the mind when the ideas, concepts and facts are correlated or aligned in their proper perspective, the individual is able to understand new ideas and concepts.

In a training situation (Kaplan, 1964), the ability of individuals to utilize insight varies and this variation must be taken into consideration when attempting to teach new ideas to occupational safety and health students. Cognitive restructuring and insight take place in ways that are simply not reducible to the atomistic conceptions of behaviorists (Gage and Berliner, 1979).

SOCIAL LEARNING, IMITATION, MODELING

Imitation Learning

In their first book, Social Learning and Imitation, Miller and Dollard (1941) state their basic interpretation and then proceed to apply it to a variety of complex situations. They note that much human learning behavior involves imitation. In industrial settings individuals solve problems usually doing what they see someone else doing. If the XYZ Company has achieved a good safety record through a behavior modification program, other companies will attempt to imitate the basic approach used ty the XYZ Company.

Why companies will imitate another companies successful safety program involves some interesting logic. No doubt, time, money and manpower will be saved by actually copying, for instance, a behavior modification program which has been tested and proven successful by another company. Success is measured by a reduced accident frequency rate.

A parallel example can be related here to aircraft research, design and testing. Since the beginning of aviation, almost back to the Wright Brothers' first flight in 1903, the military has designed and tested all types of aircraft including reciprocating engine aircraft, jet powered aircraft, and now rocket propelled space craft. A historical graph will show that the military and/or government financed aircraft are a few years ahead of civilian design and manufacture. For instance, presently we are beginning a transition from the NASA (government financed) space flights to civilian modifications and use.

According to Miller and Dollard, the tendency to imitate is itself learned. The Miller-Dollard model of learning implies that when a person makes a response (Hill, 1977, p. 238), it is often done in the presence of cues produced by the behavior of others. If the response is followed by drive reduction, the individual has been rewarded for using the cues from another individual to model his response after the other's. When the imitative behavior is rewarded, the individual learns to do what he/she sees the other persons do.

An interesting aspect of the Miller and Dollard theory is their application of imitation principles to social situations. They point out that people learn to imitate high-prestige people rather than those of low prestige. This principle has clear applications to industrial training situations.

Albert Bandura's work has contributed to the resurgence of interest in imitation. Bandura and Richard Walters collaborated on a book entitled, Social Learning and Personality Development (1963) in which they presented their views on imitation as well as on numerous other topics. Bandura and Walters have demonstrated that humans can learn by imitation in considerably more complicated ways than those described earlier. An individual can learn by observing someone else. In fact, a person can arrange simple responses in a complex sequence purely by observing and imitating someone else (Bandura and Walters, 1963, p. 4).

Modeling

A concept even more general than imitation is modeling. Modeling includes not only simple imitation of one person by another, but also more pervasive processes (often called identification) by which a person attempts to be the same kind of person as another. A model can be a real person or a character in history. In industry and employee's model might be his safety supervisor or foreman.

Interpretations of Social Learning, Imitation and Modeling Industrial Training

Specific safety training of employees in how to operate a forklift truck or some other type of vehicle is a common training responsibility in industry. Consider how difficult it would be to learn to operate a vehicle if every step of the process had to be shaped by Skinnerian procedures. Reinforcing the learner for each correct use of the controls would be inefficient and slow. In this type of skill learning situation it is important to master proper steering and braking techniques initially. Through observation and imitation of an experienced driver the learner can increase both the speed of learning and the chance of surviving the training course. The learner in this situation can learn much by observation of the skill performed by a professional. In addition. information can be acquired by listening. The combination of listening, watching and then having the learner perform the driving risk will result in rapid learning of the driving skill under guidance of a professional driver.

Considering all the skills and social behaviors individuals acquire from one another, such acquisition of new responses is certainly an important kind of imitation. Imitation and modeling can be used effectively in industrial training situations by trainers who understand these processes.

In addition to imitation, Bandura and Walters (1963) discussed the processes of inhibition or disinhibition of already learned responses. If, for example, an employee (learner) has already learned to make a response, but learns by observing a professional driver whether or not to make a response; for instance, in a braking situation the response could be locking brakes in certain emergencies instead of snubbing the brakes. This is called inhibition. The learner learns by observing the professional driver not to make the incorrect response and why. Disinhibition refers to the case where a learner has already both learned how to make the response and learned not to make it in a given situation, but now observes the professional driver makes the response and proceeds to do so also. Here the inhibited response has been disinhibited through a process of imitation (Bandura and Walters, 1963).

Imitative behavior is often rewarded by the model (Employer) and, in addition, brings rewarding consequences (employee incentive programs), provided the model exhibits socially effective behavior (good safety example by employer); consequently, most employees in industry develop a generalized practice of following the examples of their superiors. According to Bandura and Walters, social behavior patterns are most rapidly acquired through the combined influence of models and differential reinforcement. Industries have had success in changing employee attitudes toward safety by dispensing reinforcers according to some plan and schedule.

APPLIED BEHAVIORAL ANALYSIS IN OCCUPATIONAL SAFETY

Under the more familiar title of Behavior Modification, we have suggested several connectionist, cognitive and imitative approaches to managing safety in some detail. It should be noted, in this paper, that safety professionals are aware of the concepts developed by B.F. Skinner, but they are not aware of learning concepts such as other connectionist theories, cognitive learning approaches, social learning, imitation and modeling presented earlier in this paper. The Skinnerian approach to managing safety has been used by a few industries. The application of applied behavioral analysis in occupational safety has not yet appeared in the literature, but a general support has been emphasized (Berger, 1968; Bird and Schlesinger, 1970; McIntire and White, 1975; Peterson, 1975).

Skinner (1953) and others have suggested that the technique of applied behavioral analysis may be effectively used by industry in handling problems with quality control (Petersen and Goodale, 1980, p. 236), employee training, motivation, and discipline. The behaviorial approach departs from the traditional conception of applied psychology by rejecting the concepts of needs, impulses, desires, and drives. Instead, emphasis is placed upon the external environmental, situational, and social stimuli that influence behavior (Kazdin, 1975).

To behaviorists like Skinner (Brown, 1980), the isolation and manipulation of these stimuli are of paramount concern. Interest in establishing behaviorial programs in industry has grown within the past few years; however, the bulk of the research remains within the educational and therapeutic realms.

Behavioral Change

Behavioral change is necessary in any organization in which hazards are present, simply because it is a critical factor in the alleviation of accident potential (Aitken, 1973). Approximately 90 percent of all accidents are caused by unsafe acts by workers, and the remaining 10 percent are caused by unsafe conditions. Therefore, behavioral change is a factor necessary for accident reduction. The major concern is not whether behavior should be changed, but who will change it, what will be changed, and how will it be accomplished. Questions need to be answered by each individual organization. In the event they do not have personnel qualified to develop programs designed to bring about behavioral change in workers, possibly outside consultants need to be considered. There is a growing number of industrial psychologists who have developed successful safety programs based on behavioral concepts.

Changing Worker Behavior

The safety professional must be aware that if his workers are going to learn safety procedures they must be so motivated. To merely point out that accidents cost the company money will not motivate them. To change behavior, the safety professional must emphasize the hazards which are risked when using unsafe work procedures: the probability of serious and painful injury and the possible loss of earning power. The cost, not only in dollars but also psychologically to both the worker and his family, should motivate the worker to learn safe work methods.

It is imperative that employees know why they need to learn the right way and/or safe way to perform job tasks. They can be shown "what to do" and "how to do it", but until they understand "why" they need to use a certain safe procedure, the entire effort could be fruitless.

Affective Approaches

Safety people must appeal to fundamental human desires to be effective. Even if employees believe what they are told, for example, "Smoking will hurt your wind," there is no guarantee that they will change their behaviors. Persuasion in particular demands appeal to emotion. People act largely because of the way they feel. To persuade others, it is necessary to understand the motives which lead people to act as they do. Other motives that can be appealed to in the affective domain are the desire for security, social approval, ideals, ambition and interest in maintaining life and health, desire for wealth, love of home and family, etc.

Summary

While the concept of organizational safety climate is new, organizational climate theory is not. A brief summary of the history shows that studies in the 1930's suggested a link between perceived climate, the production employee and actual climate (Lewin, 1938). A summarization of a number of studies reviewed emphasized the importance of employee perceptions in decisions which concern the appropriateness of individual planned behavior (Lewin, 1938; Litwin and Stringer, 1968). The review of the literature indicated that the perceptions employees share about their specific work environment make up the occupational climate. The only other study of occupational safety climate, based on employee perceptions, was conducted by researcher Dov Zohar in Israel during 1980. Zohar administered an organizational safety climate questionnaire to workers in Israel. His questionnaire was administered to production workers in a stratified sample of 20 Israeli industrial organizations in 1980. Zohar found, in his study, that the chemical, metal, textile and food production workers, making up Zohar's sample, had common organizational climate perceptions. Safety performance measures such as severity rates could not be used to validate the safety perceptions of workers due to weaknesses in Israel's workers' compensation statistics. An alternative effort at validation was used by Zohar which was the correlation of safety climate scores with safety program effectiveness. Independent safety inspectors were utilized. This method was considered weak because of insufficient familiarity with the organizations evaluated by Zohar and his group of researchers.

In general, this review of literature has outlined ways in which organizational safety climate is dependent on a variety of educational and psychological factors. These factors include:

1. cognitive-developmental factors which should be a concern of management, and which need to be introduced, along with affective and humanistic domains, in order to change attitudes

of workers throughout an organization;

2. social factors, which are of concern for operant and social learning (imitation and modeling) approaches to safety climate and social behavior based on perceived effects of safe conduct on promotions and the social status of workers;
3. conceptualized needs of workers which may be interpreted according to Maslow's "hierarchy of needs" theory;
4. application of modern principles of educational psychology to the development and/or improvement of occupational safety training programs; and
5. humanistic factors including employee ratings of perceived risks and the effectiveness of guidance versus enforcement in promoting safety.

CHAPTER III

METHOD

Hypotheses

Listed are the two hypotheses which were tested:

1. There is no significant difference between "safe" and "unsafe" workers.

   a. As indicated by the item scale scores.

   b. As defined by all 50 items of the instrument. (Zohar/Holmes Safety Climate Attitude Inventory Appendix III).

2. There is no similarity between factor structures of factor loadings in American industries versus those in Israel.

Sample

Eleven industrial organizations were selected for questionnaire administration. Organization selection was accomplished from a list of organizations utilized by the University of Wisconsin-Whitewater in its intern program. The selection process involved the somewhat abitrary selection of industries with different working conditions (See Appendix VII). It was important for the study to have both high risk and low risk industrial working conditions included. The typical conditions were classified into high and low incidence rates. Incidence rates are based on the rate of accidents/illnesses per 100 employees (See definitions sections Appendix VIII). The organizations selected were accessible to the University of Wisconsin in a dual state area; namely, Illinois and Wisconsin.

The study sample consisted of 425 workers from nine industrial type organizations and two city employee groups. The total sampling was divided into two separate groups of employees (Group I & Group II). Group I consisted of 208 workers who had not experienced any accidents within the past five year period. Group II included 217 employees who had experienced at least 1 or more work related accidents within the past 5 year period. (see Table I).

Procedure

A pilot study was conducted at The Weiler Company in Whitewater, Wisconsin during August 1984. A three phase procedure was tested for the purpose of determining the feasibility of conducting The Safety Climate Study. Phase I consisted of the selection of a key contact person within the company. (The Superintendent of Manufacturing was chosen to coordinate the study internally within Weiler). Phase II involved the random selection of 20 workers from two groups of employees. Group I included employees who had not suffered a work related accident within the past five year period; whereas, Group II was made up of workers who had experienced at least one work-related accident in the past 5 years. Phase III consisted of the random distribution of the attitudinal safety climate inventory to the two groups of employees. The inventory plus a set of instructions were distributed in a self-addressed envelope for mailing to the Department of Safety Studies, University of Wisconsin-Whitewater. Each envelope was coded for specific employee recognition and company identification. This information was needed for data analysis purposes only.

The Weiler Company employs approximately 100 persons in various jobs related to the fabrication of commerical meat grinders and mixers.

As a result of the success of the three-phase procedure, and the excellent internal company coordination of the study at the Weiler Company, it was decided to expand the study to include eleven industrial organizations, including Weiler. Table I includes a list of the eleven organizations. The number of employees varied from 100 to 5.500 workers in the eleven industrial organizations.

INSTRUMENTATION

Based on the review of safety literature and recommended research procedures, seven organizational dimensions were included in the safety climate attitude inventory. The first 40 inventory items were similar to those used by Dr. Dov Zohar in his 1980 safety climate study conducted in Israel. This researcher developed 15 additional items needed for added validity and scale reliability in two of the dimensions; namely, perceived effectiveness of enforcement versus guidance in promoting safety, and the perceived effects of safe conduct on social status. The additional items on enforcement versus guidance sought the employee's perceptions relative to supervisor guidance being more important than enforcement of safety rules. Other items were designed for comparing counseling by supervisors as being more effective than punishment or reprimand.

As for the additional items on perceived effects of safe conduct or social status, the items were designed to rate the importance of safe conduct on improving social status among employees. The "safe" and "unsafe" groups were asked to record their perceptions on a unidimensional 6 point Likert Scale ranging from high disagreement to high agreement with the added statements dealing with social status as well as guidance versus enforcement

Once the safety attitude inventory was finalized it was mailed to five safety directors and/or managers for review purposes. A letter accompanied the inventory requesting the company's cooperation in administering the inventory as a method of measuring the safety climate in their organization. Furthermore, the letter stated that the project was aimed at measuring what employees presuppose about organizational safety so that management may better pinpoint health and safety problems. The safety directors were requested to review the inventory items to determine their feasibility and readability. Also they were asked to react to the sample "directions to workers" and to make changes and/or deletions on the inventory form (See Appendix II).

The performance data were collected following the completed revision and preparation of the inventory. Each company was provided a total of 80 inventories which were distributed to the "safe" and "unsafe" groups on a random bases by the key contact person who, in most cases, was the company safety director or manager The Three step plan used at the Weiler Company was followed in conducting the study in the 10 additional industries Below is a list of industrial organizations and the number of returns from the "accident" and "no accident" groups

Each employee, randomly selected was provided a packet containing (1) the 50 item inventory. (2) letter of introduction and statement of confidentiality and (3) a self-addressed and stamped envelope to be returned to the Safety Studies Department, University of

Wisconsin-Whitewater. Each self-addressed envelope was coded for specific employee identification, e.g., "(A) accident" group versus "(NA) non-accident" group in addition to a company indentification code.

TABLE I

PERFORMANCE SITES AND INVENTORY RESPONSES

	Group I No Accident	Group II Accident	Return %
Safety Organization			
Schneider Transportation	27	23	62.5
Safety-Kleen Corporation	18	16	42.5
Ambrosia Chocolate Co.	25	23	60 0
City of Kenosha	11	50	76.2
Signode Corporation	30	21	63.7
American Brass-	19	14	41.2
Arco Metals			
The Larsen Co. (1)	15	23	47.5
The Larsen Co. (2)	31	21	65.0
Mercury Marine	17	18	43.7
Milwaukee Metropolitan Sewerage District	2	0	00.025
Weiler Corporation (pilot study 40 questionnaires)	13	10	57.5

These data were used for analysis purposes only, with confidentiality maintained. The inventory data collection period was from October 1, 1984 through November 15, 1984.

After the data collection period, a three-week pre-data computation-period similar to a baseline period was determined. This allowed the researcher to follow-up with company personnel directly. In some cases, where companies were delayed in distributing the inventories to workers, follow-up phone calls and reminder letters were mailed to safety contacts.

DESIGN AND STATISTICAL ANALYSIS

Initially, the data collected from Zohar's 40 item questionnaire were factor analyzed with SPSSX using principal component factor analysis with varimax Rotation. Table III displays the 8 factors obtained. The results of the American study differ significantly from Dr. Dov Zohar's Israeli study (See Table VI).

Table VI shows the results of comparing Zohar's original 40 questions with the American (Loyola) sample. Tables IV and V specify the item numbers loading on each factor. Two major differences between Zohar's study and the Loyola study can be noted in Table VI. First there is a significant difference in the order of the factor descriptions based on the principal-component factor analysis and the item loadings on factors (Loyola Study) were somewhat different than the Israeli item loadings. In view of these differences especially in the order of factors, the null hypothesis is not rejected.

The quartimax procedure initially resulted in fourteen factors. Several factors were combined to confirm the validity of the logic method used. Those items which logically clustered together, factors were combined to form factorially complex scales. This is explained in

Table VIII.

The Factor Transformation matrix composed of 14 Factors is contained in Table X. The initial factor analysis using principal component factoring with iteration subsequent to the orthogonal Quartimax Rotation resulted in 14 factors Table VIII illustrates all 14 factors and their respective factor loadings. Factors 8, 9, 10 11, 12, 13 and 14 have been combined with common factors 1 through 7.

First, logic was used, followed by analytical methods (factor analysis); and then a return to logic. Scale complexity is displayed in Table VIII.

For example, factors 8 and 13, both having eigenvalues of 1.37 and 1.08 respectively, were retained to conform the validity of factors 6 and 7. Table XI lists these factors and their respective eigenvalues. An eigenvalue of 1.00 is the lowest recommended for factor retention (Guttman, 1954). This was done because in discriminant analysis used in this study, it proved to be a high discriminant value.

The dimensions (factors) include those organizational characteristics which were found to discriminate between high versus low accident-rate companies.

The procedure used, included steps to create norms following the development of scale scores. Scales scores were created on each of the seven factors. A minimum of four items was used for scale reliability of the loadings on each factor. A minimum item loading of .30 was utilized, Once the scale scores were determined in a linear combination, (addition was then used to obtain a scale score). The Likert Scale items in the test instrument had dimensions of 1 through 5.

A total attitude score was detemined by this procedure and the average sum for all scores was then calculated. A multivariate analysis of variance was conducted which indicated significance in four of the seven factors.

Cronbach's Coefficient Alpha was used to calculate estimates of reliability for each of the seven scales as well as for the total instrument (See Table XXXIV). Cronbach's Alpha Coefficient of .8599 indicated a strong positive reliability of safety climate (See Table XXXVI).

Differences between scale scores were determined using discriminant analysis of all 50 items. The two important variables of the study, the "safe" versus "unsafe" groups were analyzed utilizing discriminant analysis. The Spearman-Brown Split-half reliability on items (1-50) resulted in a reliability coefficient for part 1 (.7831) & for part 2 (.7256).

When examining the factor structure it is apparent that some items have complexity. Since the factor analysis of this instrument indicates a substantive departure from Zohar's study, the factor structure was re-examined to create scale values. It should be noted here that the 14 factors yielded sub-scales in cases where the factors contained too few items to be considered reliable. The combining of factors lead to factorially complex scales. These factorially complex sub-scales then, yielded reasonable estimates of reliability. Appendix VI relates the manner in which these factors Linearly combined to form sub-scales. Those items having the highest complexity are also displayed in Appendix VI.

Summary

In this chapter the following problems were addressed:

1. Hypothesis one deals with the differences between "safe" and "unsafe" workers. Part A was indicated by the item scale scores. Part B was analyzed, as defined by all 50 items of the test instrument using discriminant analysis. Hypothesis two deals with the similarities of factor structures in American industries versus those in Israel.

2. The description of the sample was presented. The total sample consists of 427 workers from eleven industrial organizations. The total sampling is divided into two groups; Group I consists of 208 workers who had not experienced an accident within the past 5 years and Group II includes 219 workers who had experienced one or more accidents within the past 5 year period.

3. Procedures along with the instrumentation, design and statistical procedures include factor analysis, discriminant analysis, scale scores, multivariate and univariate analysis of variance and Cronbach's Coefficient Alpha, and the Spearman-Brown split-half reliability coefficient. These measures were used to make comparisons of safety climate scores between companies analyzed in this study. Also content analysis and logical methods were used to determine safety climates in the industrial organizations included in this present study. Greater detail of the analyses will be provided in Chapter IV.

TABLE II

ZOHAR'S ISRAELI STUDY TABLE

Principal Components Factor Analysis-Safety

Climate Questionnaire

Zohar's Original 40 Items

Factor	Eigenvalue	% of variance	No. of Question-naire Item
perceived importance of safety training program	9.84	40.9	6
perceived management attitudes toward safety	4.63	19.3	9
perceived safe conduct on promotion	2.53	10.6	7
perceived level of risk at workplace	2.34	9.7	5
perceived effects of required work pace on safety	1.66	6.9	3
perceived status of safety officer	1.17	4.8	5
perceived effects of safe conduct on social status	1.07	4.4	2
perceived status of safety committee	.84	3.4	3

TABLE III

Loyola (American) Study

Principal-Components Factor Analysis of

The Safety Climate Questionnaire

Zohar's Original 40 Questionnaire Items

Factor	Eigenvalue	% of variance	No of question-naire items
perceived management attitudes toward safety	7.74	19.4	9
perceived status of safety officer	2.92	7.3	5
perceived effects of safe conduct on social status	2.11	5.3	3
perceived eeffects on safety conduct on promotion	1.72	4.3	6
perceived level of risk at workplace	1.49	3.7	5
perceived effects of required work pace status safety	1.42	3.6	3
perceived importance of safety training	1.26	3.2	5
perceived status of safety committee	1.20	3.0	3

TABLE IV

Loyola (1985) Safety Climate Study

40 Item Safety Climate Questionnaire

Factor Description	Item Number
perceived management attitudes toward safety	5, 6, 11, 14, 18, 21, 14, 27, 36
perceived status of safety officer	10, 23, 31, 38, 40
perceived effects of safe conduct on social status	8, 12, 28
perceived effects of safe conduct on promotion	4, 20, 30, 32, 33, 35
perceived level of risk at workplace	3, 15, 22, 26, 34
perceived effect of required work pace on safety	2, 13, 20
perceived importance of safety training programs	7, 12, 25, 29, 39
perceived status of safety committee	1, 17, 19

TABLE V
Zohar's (1980) Israeli Safety Climate Study

Safety Climate Questionnaire

40 Item Safety Climate Questionnaire

Factor Description	Item Number
perceived importance of safety training programs	7, 12, 25, 29, 33, 39
perceived management attitude toward safety	5, 6, 11, 14, 18, 21 24, 27, 36
perceived effects of safe conduct on promotion	4, 13, 20, 28, 30, 32, 35
perceived level of risk at workplace	3, 15, 22, 26, 34
perceived effects of required work pace on safety	9, 16, 37
perceived status of safety officer	10, 23, 31, 38, 40
perceived effects of safe conduct on social status	2, 8
perceived status of safety committee	1, 17, 19

TABLE VI

Comparison of Safety Climate

Questionnaire Factors & Item Loadings in American Study Versus Zohar's Israelie Results

Factor Description	Factors Zohar	Factors American	Zohar's Item No.'s	American Item No's	Eigenvalues Zohar	Eigenvalues American	Comments
Perceived importance of safety training programs	1	7	7,12,25,29,33, 39	7,12,25,29, 33,39	9.84	1.26	
Perceived management attitudes towards safety	2	1	5,6,11,14,18, 21,24,27,36,	5,6,11,14,18, 21,24,27,36,	4.63	7.74	
Perceived effects of safe conduct on promotion	3	4	3,13,20,28,30 32,35	4,13,20,28,30, 32,35	2.53	1.72	
Perceived level of risk at workplace	4	5	3,15,22,26,34	3,15,22,26,34	2.34	1.49	
Perceived effects of required work pace on safety	5	6	9,16,37	9,16,37	1.66	1.42	Combined factors F-6 & F11
Perceived status of safety officer	6	2	10,23,31,38,40	10,23,31,38,40	1.17	2.92	
Perceived effects of safe conduct on social status	7	3	2,8,	8,12,28	1.07	2.11	
Perceived status of safety committee	8	8	1,17,19	1,17,19	.84	1.20	

TABLE VII

FACTOR LOADINGS

F1		F2		F3		F4		F5		F6		F7	
I_{5}	.31	I_{4}	.61	I_{3}	.62	I_{8}	.40	I_{1}	.68	$I._{42}$	.70	I_{2}	.37
I_{6}	.70	I_{29}	.32	I_{9}	.75	I_{12}	.43	I_{10}	.51	$I._{44}$	.39	I_{13}	.67
I_{7}	.35	I_{30}	.75	I_{15}	.74	I_{28}	.69	I_{17}	.58	$I._{47}$	.41	I_{19}	.65
I_{11}	.70	I_{33}	.68	I_{16}	.36	I_{31}	.50	I_{23}	.49	$I._{48}$	.56	I_{20}	.60
I_{14}	.77	I_{35}	.35	I_{22}	.49	I_{32}	.50	I_{40}	.42	$I._{49}$	.60	I_{41}	.59
I_{18}	.75	I_{39}	.35	I_{26}	.68	I_{38}	.42			$I._{50}$	.51	I_{45}	.65
I_{21}	.64			I_{34}	.66							I_{46}	.68
I_{24}	.65			I_{37}	.62								
I_{25}	.49												
I_{27}	.75												
I_{36}	.79												
I_{43}	.59												

SCALE COMPLEXITY

SCALE	SCALE LABELS	ITEM COMPOSITION	ITEM LOADING & COMPOSITION		ITEM IDENTIFIERS
1	Management Attitude	F1 + F9	For F_1		
			I_5	.75533	Supervisor Informed
			I_6	.70110	General Manager Informed
			I_7	.35696	Training Worthy Investment
			I_{11}	.70941	Management Willing to Invest $
			I_{14}	.77612	Management Informed Safety
			I_{18}	.75533	Managers Care Risk Levels
			I_{21}	.64054	Manager View Safety Reg's Seriously
			I_{24}	.65404	Safety Issues High Priority
			I_{25}	.49033	Training Investment ($) Pays
			I_{27}	.75927	Manager Controls Hazards
			I_{36}	.79017	Management Adopts New Ideas
			For F_9		
			I_{43}	.59271	Important For Supervisor-Point Out Hazards
			For F_2		
2	Safe Conduct/ Promotion	$F_2 + F_6 + F_7$	I_4	.61479	Safe Worker Promoted
			I_{29}	.32352	Trained Worker Safer.
			I_{30}	.75671	Safety Affects Evaluation
			I_{33}	.68164	Trained Worker Promoted
			I_{35}	.35461	Accident Affects Reputation
			I_{39}	.40158	Trained Worker Better Job
			For F_6		
			I_{35}	.47576	Accident Affects Reputation
			For F_7		
			I_4	.33471	Safe Worker Promoted

SCALE	SCALE LABELS	ITEM COMPOSITION	ITEM LOADING & COMPOSITION		ITEM IDENTIFIERS
3	RISK LEVEL	$F_3 + F_9 + F_{12} + F_{13}$	For F_3		
			I_3	.62283	Risk Level Concern
			I_{15}	.74313	Chance of Accident Large
			I_{16}	.36697	Premium System No Time For Safety
			I_{22}	.49773	Matter of Time Before Accident
			I_{26}	.68629	Job Safety Problems Serious
			For F_{13}		
			I_{37}	.30168	Workers Not On Premium System Safer
			For F_{12}		
			I_9	.75955	Safe & Unsafe Workers
			For F_{14}		
			I_{34}		This Factory Dangerous
4	Safety Training	$F_4 + F_1$	For F_4		
			I_8	.40825	Best Guys Care About Safety
			I_{12}	.43687	Safety Training Helps Job/Home
			I_{28}	.69403	Those Who Work Safely Emphasize it
			I_{32}	.50168	Managers Recall Accident/Involver
			I_{38}	.42241	Dangerous Situation Reported
			For F_1		
			I_8	.34755	Best Guys Care About Safety
			I_{12}	.44614	Safety Training Helps Job/Home

SCALE	SCALE LABELS	ITEM COMPOSITION	ITEM LOADING & COMPOSITION		ITEM IDENTIFIERS
5	STATUS OF SAFETY OFFICER	$F_5 + F_1 + F_2 + F_8 + F_{13}$	For F_5		
			I_1	.68638	Safety Committee Warning Affects Behavior
			I		
			I_{10}	.51915	Safety Officer Influence Great
			I_{17}	.58510	Safety Committee Positive Effect
			I_{23}	.49289	Safety Officer Opinion Affects Evaluation
			For F_1		
			I_{10}	.50856	Safety Officer Influence Great
			I_{17}	.49227	Safety Committee Positive Effect
			I_{40}	.42670	Safety Officer Regulation Considered
			For F_2		
			I_{23}	.37005	Safety Officer Opinion Affects Evaluation
			For F_8		
			I_{31}	.50641	Workers Using PPE not Cowards
			For F_{13}		
			I_{31}	.36339	Workers Using PPE not Cowards
6	Enforcement v/s Guidance	$F_6 + F_1 + F_{13}$	For F_6		
			I_{47}	.41254	Atmosphere Free of Threat Etc.
			I_{48}	.56843	Supervisor's Understanding
			I_{49}	.60483	Supervisor's Humanistic
			I_{50}	-.51318	Supervisor Make Me Feel Lower Class

SCALE COMPLEXITY (cont.)

SCALE	SCALE LABELS	ITEM COMPOSITION	ITEM LOADING & COMPOSITION		ITEM IDENTIFIERS
			For F_1		
			I_{48}	.52490	Supervisor's Understanding
			I_{49}	.50701	Supervisor's Humanistic
			I_{47}	.33321	Atmosphere Free of Threat Etc.
			For F_{13}		
			I_{42}	.70309	Supervisor Guidance Over Enforcement
			I_{44}	.39855	Corrective Counseling More Effective Than Punishment
7	Social Status	$F_2 + F_6 + F_8 + F_{10} + F_{11}$	For F_7		
			I_2	.37053	Worker's Violations Aggravate Others
			I_{13}	.67733	Reckless Behavior Negative Evaluation
			20		
			I_{20}	.60337	Worker's Violation Adverse Effect Evaluation
			For F_6		
			I_2	.33545	Worker Violation's Aggravate Others
			For F_8		
			I_2	.40034	Worker's Violations Aggravate Others
			I_{41}	.69090	Worker's Conduct Improves Social
			For F_{10}		
			I_{45}	.65160	Employee's Self Evaluation
			I_{46}	.68637	Coping With Feelings of Others
			For F_{11}		
			I_{19}	.65215	Status Belonging to Safety Committee

TABLE IX

IDENTIFICATION OF SCALE COMPELXITY

THOSE ITEMS WITH THE HIGHEST COMPLEXITY:

F_7	ITEM 2 =	3 FACTOR LOADINGS F_6, F_7, F_8
F_2	ITEM 4 =	2 FACTOR LOADINGS F_2, F_7
	ITEM 35 =	2 FACTOR LOADINGS F_2, F_6
F_4	ITEM 8 =	2 FACTOR LOADINGS F_4, F_1
	ITEM 12 =	2 FACTOR LOADINGS F_4, F_1
F_5	ITEM 10 =	2 FACTOR LOADINGS F_5, F_1
	ITEM 17 =	2 FACTOR LOADINGS F_5, F_1
	ITEM 23 =	2 FACTOR LOADINGS F_5, F_2
F_6	ITEM 47 =	2 FACTOR LOADINGS F_6, F_2
	ITEM 48 =	2 FACTOR LOADINGS F_6, F_1
	ITEM 49 =	2 FACTOR LOADINGS F_6, F_1

TABLE X

FACTOR TRANSFORMATION MATRIX

FACTOR TRANSFORMATION MATRIX:

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8
FACTOR 1	.87361	.22751	-.07304	.25576	.17438	.15094	.08821	.16845
FACTOR 2	-.24125	.44409	.48437	.19119	.30421	-.27791	.23047	.15698
FACTOR 3	.08698	-.67940	.44462	.16097	.11510	-.08476	.00844	.03346
FACTOR 4	.23452	-.09974	.28082	-.31474	.40568	-.04434	-.21575	-.33635
FACTOR 5	-.02796	-.06019	.33876	.11133	-.32351	.66644	-.09286	.22269
FACTOR 6	-.02303	-.05720	-.27876	-.00632	.08740	.03019	-.62968	-.14605
FACTOR 7	.22944	.12626	.25102	-.62024	-.41011	-.03682	.18889	-.28111
FACTOR 8	-.10128	-.25535	-.08506	-.02110	.44171	.40561	.38522	-.28347
FACTOR 9	.09159	-.19323	-.33243	-.19839	.05405	-.23512	.34236	.10110
FACTOR 10	.11792	.08624	.26320	.23249	-.16077	-.13298	-.07185	-.43823
FACTOR 11	.16387	-.32868	.04545	.12307	-.17166	-.44173	-.06948	.23825
FACTOR 12	-.00395	.15209	.15995	-.29886	.35425	.00377	-.39134	.27202
FACTOR 13	.05033	-.11159	.11435	-.18586	-.14157	-.02867	-.09282	.29334
FACTOR 14	.01164	.05532	-.01684	.37823	-.14093	-.10479	-.11970	-.42821

	FACTOR 9	FACTOR 10	FACTOR 11	FACTOR 12	FACTOR 13	FACTOR 14
FACTOR 1	.10092	.08613	.07390	-.03440	.02621	.00445
FACTOR 2	.31085	.15871	-.09185	.18113	.22014	.11982
FACTOR 3	.12172	.18276	.27860	-.25269	-.09150	.29590
FACTOR 4	.05483	-.49591	-.24404	.31171	-.14753	.05910
FACTOR 5	-.11540	-.02761	-.27430	.30090	.17241	.22770
FACTOR 6	.46086	.29767	-.11348	-.00096	.39055	.16023
FACTOR 7	.10925	.22295	.26226	.02847	.25912	.03294
FACTOR 8	-.01457	.28123	-.02759	.11754	.24659	-.41688
FACTOR 9	-.15470	.28266	-.44857	.21966	-.04092	.51361
FACTOR 10	-.25533	.21148	-.55690	-.41880	.01158	-.13787
FACTOR 11	-.18693	-.13699	-.05913	.30815	.51179	-.38422
FACTOR 12	-.59177	.36994	.14414	-.02489	-.00771	-.02816
FACTOR 13	.37090	.33083	-.26530	.16158	-.52048	-.45547
FACTOR 14	-.16025	.28319	.29197	.59539	-.27534	.05918

TABLE XI

FINAL STATISTICS

VARIABLE	COMMUNALITY	FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT
ITEM 1	.56227	1	8.75597	17.5	17.5
ITEM 2	.59227	2	3.32810	6.7	24.2
ITEM 3	.57415	3	2.23316	4.5	28.6
ITEM 4	.64735	4	1.90587	3.8	32.4
ITEM 5	.59565	5	1.77006	3.5	36.0
ITEM 6	.54273	6	1.66795	3.3	39.3
ITEM 7	.56134	7	1.45543	2.9	42.2
ITEM 8	.50520	8	1.37697	2.8	45.0
ITEM 9	.62344	9	1.28062	2.6	47.5
ITEM 10	.64107	10	1.24458	2.5	50.0
ITEM 11	.56221	11	1.19477	2.4	52.4
ITEM 12	.55444	12	1.10409	2.2	54.6
ITEM 13	.64302	13	1.08501	2.2	56.8
ITEM 14	.66060	14	1.02497	2.0	58.9

CHAPTER IV

RESULTS AND DISCUSSION

Two hypotheses were tested in the present study. The first hypothesis deals with the differences between "safe" and "unsafe" workers. The second hypothesis concerns itself with the factor structures of factor loadings in American industries (Loyola Study) versus those in Israel (Zohar's 1980 Study).

Hypothesis One

There is no significant difference between "safe" and "unsafe" workers.

The hypothesis was tested using discriminant analysis to determine seven scale scores. It was done to determine differences between "safe" and "unsafe" workers according to the seven different scales.

The model being presented here is a discriminant analysis. To begin, Box's M=5.7668. This is the discriminant result of the scale scores' (two groups) utilizing the scale scores as the dependent variable. Box's M is a test of homogeneity of variance. In this present research the variance covariance matrices are homogeneous. Furthermore, in the study P=.1259 meaning that the F-Ratio (F=1.91) is not significant at the .12 level.

The overall objectives of this discriminant analysis are:

1. Any significant difference between the K groups (2) are measured by P variables (7 Scale scores)-(Dependent Variable) i.e., are group (K) (Independent Variable) centroids different?

(In this study we had two groups (K) and seven (P) variables on scale scores. (Centroids are the multivariate means).

2. What is the distance between the groups (centroids)? In this study there is an overlapping of the centroids meaning that there is a low probability of predicting group membership.
3. What is the direction of the differences? (Figure 1) Group Centroids 1(0.19083) 2(-0.21294).
4. How accurately can we predict an unclassified subject into a group? The discriminante analysis classification results indicate that 57.99% of grouped cases were correctly classified.

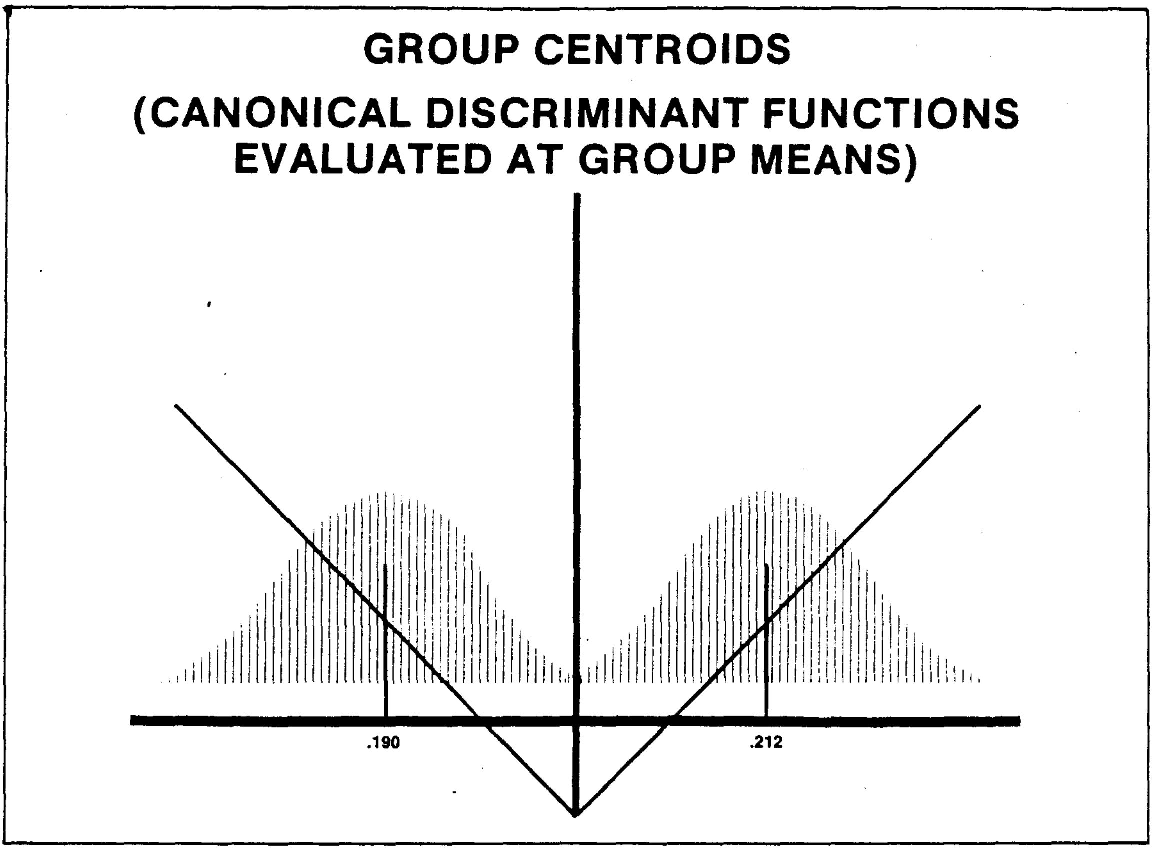
Using a linear combination, the centroids were plotted as shown in Figure 1. The large degree of overlap causes errors in predictability.

A two group discriminant analysis is similar to regression analysis using a dummy variables. (With two groups, there is one function only, and with three groups there are two functions; with 4 groups there are three functions for predicting group membership. There is always one less function than the number of groups).

In this present study ROA's V has been utilized meaning that all of the questions are answered simultaneously in a stepwise procedure.

Presented here in this analysis are a group correlation matrix, a covariance matrix, plot of the centroid means, Box's M test of

FIGURE 1


GROUP CENTROIDS
(CANONICAL DISCRIMINANT FUNCTIONS
EVALUATED AT GROUP MEANS)
.190
.212

homogeneity, means and the standard deviations, and a correlation matrix. A prior probability of 0.5 was used for each group. (Total number of cases NA=183 A=164-a difference of 19 cases). The Standardized classification function was used because of the significant differences of means and standard deviations; otherwise, the unstandardized function would have been used.

RAO's V is a measure of the distance between the two centroids. Its significance is tested by the size of the F-ratio. The results of the stepwise procedure are summarized in Tables XIV to XVI.

TABLE XII

Stepwise Variable Selection

Selection Rule: Maximize RAO's V	
Maximum No. of steps	14
Minimum Tolerance Level	0.00100
Minimum F to enter	1.0000
Maximum F to enter	1.0000
Minimum Increase in RAO's V	.0

The largest F value is the most significant F which is 8.92 in scale 3. This means that Scale 3, with an F value of 8.92, has more variability than any other scale. Scale 3, then, will be the first variable entered into the equation.

TABLE XIII

Variables Not in the Analysis after Step 0

Variable	Tolerance	Min. Tolerance	F to enter	RAO's V
Scale 1	1.00	1.00	7.85	7.85
Scale 2	1.00	1.00	.81	---
Scale 3	1.00	1.00	8.92	8.92
Scale 4	1.00	1.00	2.32	2.32
Scale 5	1.00	1.00	2.29	2.29
Scale 6	1.00	1.00	.42	---
Scale 7	1.00	1.00	2.03	2.03

TABLE XIV

WILK'S LAMBDA

Wilk's Lambda	.974	1-345	0.0030
Equivalent F	8.926	1-345	
RAO's V	8.926	1	0.0028

At step one, scale three had the largest F value (8.92) which is the only one included. It is highly significant at the .003 level and it is significant in predicting group membership. Lambda (.974) will always be 1.0 or less. Unlike RAO's V, the smaller the Lambda value the more significant it will be.

TABLE XV

Variables Not in the Analysis After Step 1

Variable	Tolerance	Min. Tolerance	F to enter	RAO's
Scale 1	0.96	0.96	5.02	14.10
Scale 2	1.00	1.00	.75	
Scale 4	0.99	0.99	2.03	11.01
Scale 5	0.99	0.99	2.61	11.61
Scale 6	0.99	0.99	.53	
Scale 7	0.99	0.99	2.59	11.59

Table XVI shows the proportions of in group variability not accounted for by Scale 3. This means that the proportion of in group variablity is not accounted for by the first variable in the equation. This will change each time more variables are added to the equation.

The most significant variable in the prediction of group membership is Scale 3. Included are all items in scale 3. The Standardized Canonical function coefficients were used to provide classification results. These are weight values and they determine the correct and incorrect classifications in the study.

TABLE XVI

CLASSIFICATION FUNCTION COEFFICIENTS
(Fisher's Linear Discriminant Function)

	1 No-Accident	2 Accident
Scale 1	.707	.736
Scale 3	.999	.948
(Constant)	-27.15	-27.30

TABLE XVII

Canonical Discriminant Functions

FUNCTION	EIGENVALUE	% VARIANCE	CUMMULATIVE %	CANONICAL CORRELATION	LAMBDA	CHI SQ	DF	SIGNIFICANCE
1	.04087	100.00	100.00	0.198	0.96	13.7	2	.0010

λ is associated within Canonical Discriminant function which accounts for 19.8% of Variablity.

Standardized Canonical Discriminant
Function Coefficients

Function 1 X_{S1}, G1 = 42.31 X_{S1},G1 (-.61)

Scale 1 - 0.61 X_{S1}, G2 = 44.87 X_{S1},G2 (-.61)
Scale 3 0.67 X_{S3}, G1 = 23.01
X_{S3}, G2 = 21.27

(Provides misclassification results Relative size indicates degree of importance)

If $X_1 > X_2$ then the person will be classified into group 1.

Any one score for an individual can be abbreviated. For example:

Score Y_1 = .707 (Scale 1) + .999 (Scale 3) - (-27.15)

Y_2 = .736 (Scale 1) + .948 (Scale 3) - (-27.30)

If $Y_1 > Y_2$ Then the person belongs in G1

If $Y_2 > Y_1$ " " " " " G2.

Using these values we can predict group membership for an unclassified member in a group. In this study we can predict group membership with only a 57.99% accuracy.

The larger the function coefficient (weight) the more important the variable. The closer they are together the less the predictibility.

The eigenvalue of .04087 is directly related to the proportion of variability included in the present study. The larger the eigenvalue the greater the proportion of variability accounted for. Therefore, .198 is 19.8% of the total variability. Scale 1 and Scale 3 together comprise 19.8% of the variability.

The group 1 and group 2 means indicate much overlapping. As a result, there is not much predictability. The percent of "grouped" cases correctly classified in this study is 57.99 percent.

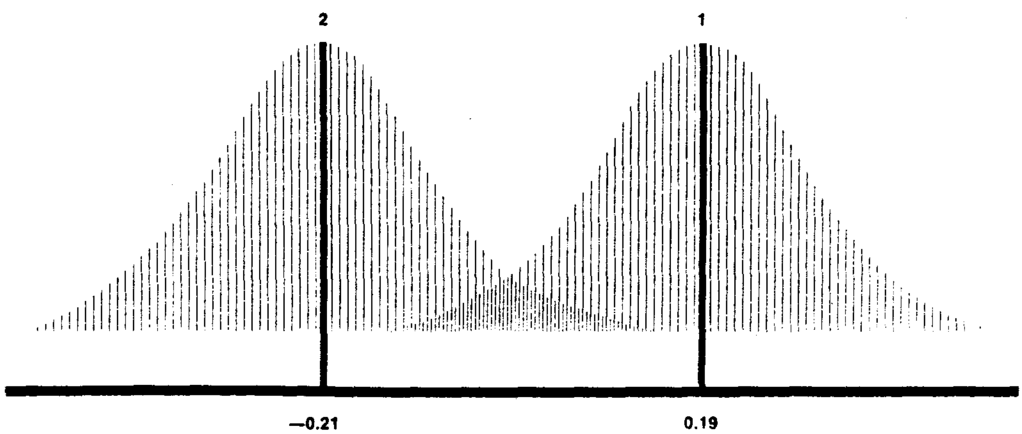
<u>Hypothesis Part B</u>

This is a summary of the tests for statistical significance of part B of Hypothesis one which states that: There is no significant difference between "safe" and "unsafe" workers as defined by all 50 items of the Holmes/Zohar Safety Climate Attitudinal Inventory the evaluation instrument. Presented here are the following: discriminant analysis including a group correlation matrix; canonical discriminant functions; plot of the centroid means; Box's test of homogeniety; means

FIGURE 2

Canonical Discriminate Functions Evaluated at Group Mean (Group Centroids)

Group	Function 1
1	0.190
2	−0.212



and standard deviations; F scores; Fisher's Classification Function and other classification results.

Box's M is a test of homogeneity and in this analysis it states whether or not the variance covariance matrices are the same for each item score. The Box's is was 96.37 which means that the variance covariance matrices are homogeous.

In the present study, P = 0.1200 which means that the F ratio is most likely independent at the 0.12 level.

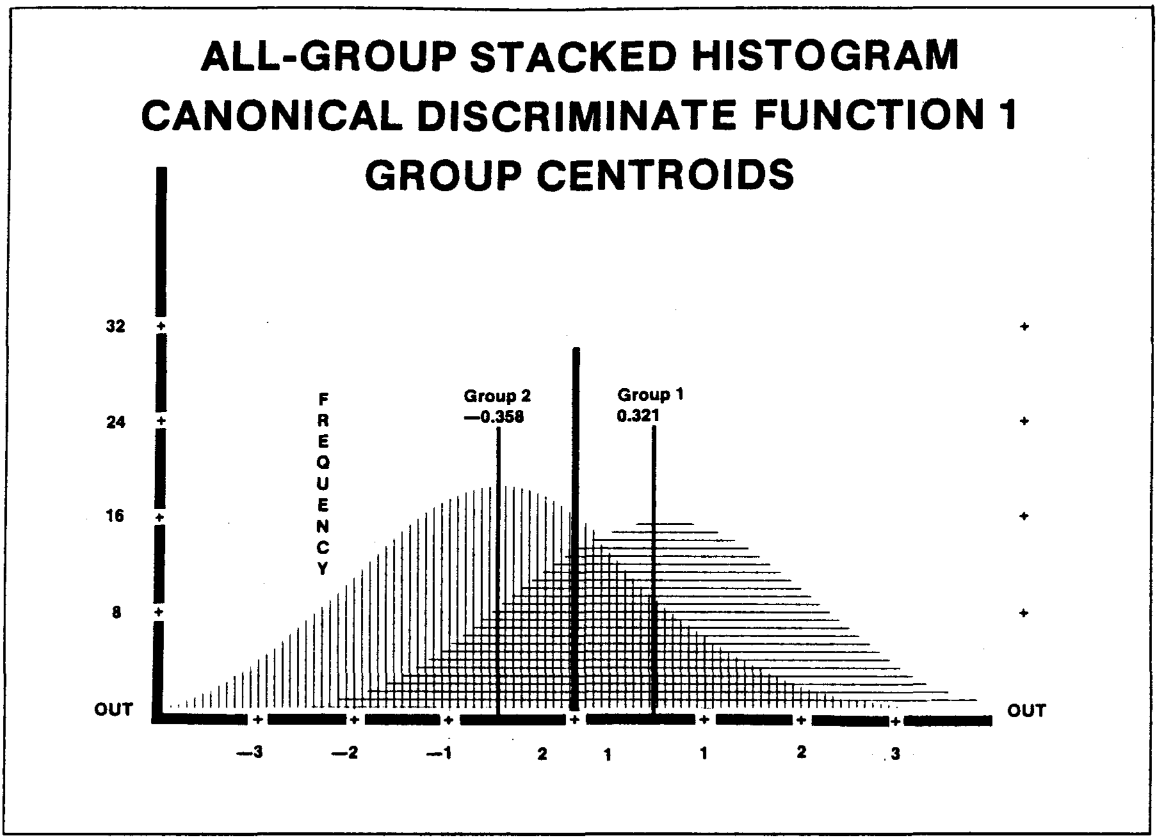
The overall objectives in testing part B of the hypothesis, using discriminant analysis on the 50 items, are as follows:

1. Is there any significant difference between the K groups (Groups 1 & 2) the independent variable, as measured by P variables, the dependent variable inventory items (50)? (i.e., are the group centroids different)? In this part of the study we had two groups (K) and fifty (P) variables or inventory items.
2. Determine the distance between the groups (centroids). Evaluation of the Canonical Discriminant Functions indicated the following means:

Group	Function 1
1	0.32161
2	- 0.35888

3. The overlapping of the group means (centroids) results in a fairly low probability of predicting group membership.
4. The percent of accuracy in predicting an unclassified subject into a group is 65.88% which is the percent of "group" cases

FIGURE 3


ALL-GROUP STACKED HISTOGRAM
CANONICAL DISCRIMINATE FUNCTION 1
GROUP CENTROIDS
32
24
16
8
OUT
FREQUENCY
Group 2
—0.358
Group 1
0.321
OUT
—3
—2
—1
2
1
1
2
3

correctly classified in this study.

In Figure 3 one can observe a large degree of overlapping of the group centroids which will cause errors in predictability.

In a two group discriminant analysis, such as this one, we have one independent variable, and fifty dependent variables.

In this study, a prior probability of 0.5 was used for each group. The predicted group membership is illustrated in Table XXIX.

RAO's V, illustrated in the summary Figure 3 actually measures the distance between two centroids. Its significance is tested by the size of the F ratio. Thus, a variable selected on the bases of RAO's V may be decreasing within-group cohesion while it adds to overall separation.

When there are a large number of cases, as in this study, V has a sampling distribution approximately the same as chi-square with degree of freedom equal to p(g-1). The change in V due to the addition (or deletion) of variables also has a chi-square distribution with degrees of freedom equal to (g-1) times the number of variables, added (deleted) at that step. It can be used to test statistical significance of the change in the overall separation. A change that is not significant should not be included. However, even if a variable is significantly entered, and doesn't change much, it can have statistical significance but not practical significance. As the centroids are moved further apart, the more accurately one can predict group membership. If F is less than 1.0 RAO's V cannot be computed.

In the summary table is a column for Wilk's Lambda. Item 21 has the highest Lambda of 0.968 which is significant at the 0.0009 level. Lambda's will always be 1.0 or less and the smaller it is the more

TABLE XXVIII

SUMMARY TABLE

STEP	ACTION ENTERED	ACTION REMOVED	VARS IN	WILKS' LAMBDA	SIG.	RAO'S V	SIG.	CHANGE IN V	SIG.
1	ITEM 21		1	0.968270	0.0009	11.31	0.0008	11.31	0.0008
2	ITEM 34		2	0.951136	0.0002	17.72	0.0001	6.418	0.0113
3	ITEM 7		3	0.941429	0.0001	21.46	0.0001	3.740	0.0531
4	ITEM 10		4	0.934730	0.0001	24.09	0.0001	2.626	0.1051
5	ITEM 19		5	0.927268	0.0001	27.06	0.0001	2.970	0.0848
6	ITEM 45		6	0.920717	0.0001	29.71	0.0000	2.647	0.1037
7	ITEM 43		7	0.913744	0.0001	32.57	0.0000	2.859	0.0908
8	ITEM 15		8	0.909130	0.0001	34.48	0.0000	1.916	0.1663
9	ITEM 27		9	0.905373	0.0001	36.06	0.0000	1.575	0.2095
10	ITEM 1		10	0.902384	0.0001	37.32	0.0000	1.262	0.2612
11	ITEM 38		11	0.899629	0.0002	38.49	0.0001	1.171	0.2792
12	ITEM 40		12	0.895986	0.0002	40.05	0.0001	1.559	0.2118

significant it will be. Therefore, each time a variable is entered, providing it has statistical significance plus practical significance, RAO's V will increase and Lambda will decrease.

The Summary Table XXVIII includes 12 inventory items which were statistically significant. The table shows each item including its Lambda significance, RAO's V, the change in V, and its significance. In all cases the V's became larger as variables were added.

It can be noted in the Summary Table XXVIII that item 40 is the most significant variable in the prediction of group membership. This is based on the largest V (40.05) and the smallest lambda (0.895). Item 40 was followed by item 38 which had the second largest V (38.49) and the second smallest lambda (0.899). At the other end of the spectrum was item 21 which had the largest lambda (0.968) and the smallest V (11.31).

Because Wilk's lambda is an inverse statistic, the variable (item 40) which produced the smallest lambda was selected for that step. It should be noted that it is possible to convert lambda into an overall multivariate F statistic for the test of group differences.

Fisher's classification function coefficients are equivalent to the unstandardized canonical function coefficients. Fisher (1936) was the first to suggest that classification should be based on a linear combination of the discriminating variables. Fisher's theory proposes a linear combination which maximizes group differences while minimizing variation within groups.

Table XIX indicated a "classification function" for group, 1 and 2, which gives the coefficients for the no-accident and accident groups.

TABLE XIX

CLASSIFICATION FUNCTION COEFFICIENTS

(FISHER'S LINEAR DISCRIMINANT FUNCTIONS)

	1 NO ACCIDENTS ACSTATUS=	2 ACCIDENTS
ITEM 1	1.1322056	1.027405
ITEM 7	.8414785	1.066751
ITEM 10	-1.152118	- 8998055
ITEM 15	1.373703	1.238058
ITEM 19	.6615241	.4971595
ITEM 21	1.228256	1.458232
ITEM 27	2.174719	2.021821
ITEM 34	1.341424	1.123246
ITEM 38	2.008979	2.182869
ITEM 40	.6096387	.431817
ITEM 43	3.626171	3.448424
ITEM 45	4.244177	4.504585
(CONSTANT)	-33.01705	-33.61921

By applying these coefficients to the raw score values, any one response of an individual can be abbreviated for example:

$$Y_1 = 1.13 \text{ (Item 1)} + .841 \text{ (Item 7)} - (-33.01)$$
$$Y_2 = 1.02 \text{ (Item 1)} + 1.06 \text{ (Item 7)} - (-33.61)$$

If $Y_1 > Y_2$ Then the person belongs in G1
If $Y_2 > Y_1$ Then the person belongs in G2

By applying these coefficients, group membership can be predicted for the unclassified member in a group. In this study group membership can be predicted with a 65.88 percent accuracy.

If X_1, G_2 X_2, G_1 then the person will be classified into group 1. The larger the function coefficient, the more important the variable. For example, item 10 has a weight of -0.50 which is twice as important as Item 15 with a function coefficient of 0.25. The closer the values

TABLE XX

CANONICAL DISCRIMINANT FUNCTIONS

	FUNC 1	
ITEM 1	0.18618	x_{11}, G_1 = 3.13
ITEM 7	-0.34301	
ITEM 10	-0.50606	x_{11}, G_2 = 3.11
ITEM 15	0.25644	
ITEM 19	0.29391	x_{17}, G_1 = 3.78
ITEM 21	-0.34092	
ITEM 27	0.24481	x_{17}, G_2 = 4.07
ITEM 34	0.43563	
ITEM 38	-0.24813	x_{17}, G_1 (0.18)
ITEM 40	0.24863	
ITEM 43	0.22633	x_{11}, G_2 (-0.034)
ITEM 45	-0.31158	

TABLE XXI

STRUCTURE MATRIX

POOLED WITHIN-GROUPS CORRELATIONS BETWEEN CANONICAL DISCRIMINANT FUNCTIONS AND DISCRIMINATING VARIABLES ARE ORDERED BY THE FUNCTION WITH LARGEST CORRELATION AND THE MAGNITUDE OF THAT CORRELATION.

	FUNC 1		FUNC 1
ITEM 24	-0.34835	ITEM 37	0.12
ITEM 11	-0.34566	ITEM 30	-0.12
ITEM 25	-0.34277	ITEM 16	0.11
ITEM 22	0.33795	ITEM 32	-0.11
ITEM 18	-0.32736	ITEM 46	-0.10
ITEM 14	-0.32512	ITEM 42	0.10
ITEM 36	-0.30110	ITEM 3	0.09
ITEM 17	-0.27946	ITEM 5	-0.07
ITEM 48	-0.25854	ITEM 33	-0.04
ITEM 26	0.24513	ITEM 9	0.04
ITEM 8	-0.24464	ITEM 23	-0.03
ITEM 12	-0.22953	ITEM 44	-0.03
ITEM 49	-0.22697	ITEM 35	0.02
ITEM 47	-0.22582	ITEM 21	0.00
ITEM 50	0.21978	ITEM 10	0.00
ITEM 6	-0.21659	ITEM 7	0.00
ITEM 4	-0.21247	ITEM 1	0.00
ITEM 20	-0.19690	ITEM 19	0.00
ITEM 41	-0.15986	ITEM 15	0.00
ITEM 2	-0.15840	ITEM 45	0.00
ITEM 13	-0.15822	ITEM 40	0.00
ITEM 28	-0.13983	ITEM 43	0.00
ITEM 31	-0.13747	ITEM 27	0.00
ITEM 39	-0.13136	ITEM 38	0.00
ITEM 29	-0.12569	ITEM 34	0.00

TABLE XXII

CANONICAL DISCRIMINANT FUNCTION

CANONICAL DISCRIMINANT FUNCTIONS EVALUATED AT GROUP MEANS (GROUP CENTROIDS)

GROUP	FUNC 1
1	0.32161
2	-0.35888

TEST OF EQUALITY OF GROUP COVARIANCE MATRICES USING BOX'S M

THE BANKS AND NATURAL LOGARITHMS OF DETERMINANTS PRINTED ARE THOSE

GROUP LABEL	BANK	LOG DETERMINANT
1	12	0.021080
2 ACCIDENTS	12	-0.236601
POOLED WITHIN-GROUPS COVARIANCE MATRIX	12	0.178695

BOX'S M	APPROXIMATE F	DEGREES OF FREEDOM		SIGNIFICANCE
96.379	1,1907	78,	366836.7	0.1200

TABLE XXIII

ACTUAL GROUP		NO. OF CASES	PREDICTED 1	GROUP MEMBERSHIP 2
GROUP	1	198	123 62.1%	75 37.9%
GROUP ACCIDENTS	2	183	55 30.1%	128 69.9%
UNGROUPED CASES		18	13 72.2%	5 27.8%

PERCENT OF "GROUPED" CASES CORRECTLY CLASSIFIED: 65.88%

are the less is the predictability.

Next, the eigenvalue of 0.11609 is directly related to the proportion of variability included in this study. The canonical correlation is a correlation coefficient of variables (ITEMS) 1, 7, 10, 15, 19, 21, 27, 34, 38, 40, 43, and 45 (TABLE XXIV). These correlation coefficients relate directly to the eigenvalue. The larger the eigenvalue the greater the proportion of variability accounted for. The canonical correlation of 0.325 accounts for 32.25 percent of the total variability. This also means that the above items account for 32.25 percent of the variability.

This facet of discriminant analysis was used in classifying the no-accident group (Group 1) and the accident group (Group 2).

The classifications results for the 198 cases under (Group 1), the no-accident group, resulted in 123 cases or 62.1% correctly classified as predicted. A total of 75 cases (Group 1) or 37.9% were classified under the predicted Group 2 membership.

Of the 183 Group 2 (accident) cases 55 or 30.1 percent were classified under the Group 2 classification. However, a total of 128 cases or 69.9% were classified as predicted, under the group 2 membership.

Next, the ungrouped cases totaled 18 and of that number, 13 or 72.7% fell under group 1 and only 5 or 27.8% were classified under group 2. The total percent of "grouped" cases correctly classified in 65.88%.

<u>FACTORIAL MANOVA</u>

The analytic technique used here is Factorial Manova with two independent variables and seven dependent variables. The model displays

ITEMS OF PREDICTABILITY

RELATED STUDY SCALE

SCALE 1	SCALE 2	SCALE 3	SCALE 4	SCALE 5	SCALE 6	SCALE 7
I_{7} Training Worthy Investment		I_{15} Chance of Accident Large	I_{38} Dangerous Situation Reported	I_{1} Safety Committee Warning Effects Safety Attitude		I_{45} Employees Self evaluation importance
I_{21} Managers View Safety Reg's Seriously		I_{34} This Factory Dangerous		I_{10} Safety Officer Influence Great		I_{19} Status of Belonging to Safety Committee Significant
I_{27} Managers Control Hazards				I_{40} Safety Officer Regulation Considered		
I_{43} Important for Supervisor to Point out Hazards						

independent and dependent variables in a 2 X 2 MANOVA for fixed effects. All treatment effects are presented about which inferences will be made. Descriptive statistics, cell means and standard deviations are displayed for the no-accident group (1) High Risk and group (2) Low Risk companies. The variable Patho labels the individual company's risk rating. The value labels for Patho are (1) "High Risk" and (2) for "Low risk".

The discriminating varibles are accident status groups (1, 2) and Patho (Risk Level)(1,2). Multivariate Analysis of Variance (Manova) Scales were formed for Scales one through seven. Data included a correlation matrix with the standard deviation, diagonal cell means-versus variances for each scale, Box plots for all variables (Scales); plus multivariate and univariate tests of significance.

There is no need to provide a graph of the interaction effects because the first order multivariate test of interaction is not significant. The hypothesis for interaction using the multivariate test of significant (effect of accident status by Patho) is presented. Finally, a review of the total findings and conclusions for the entire data set are presented and discussed. Cell means and standard deviation were calculated initially for these data. Because of the wide discrepancies, and especially the large differences in the number of cases in the high risk and low risk groups, the multivariate test (Group Centroids) for homogeneity indicated non-homogeneity of dispersion matrices.

TABLE XXV

MULTIVARIATE TEST FOR HOMOGENEITY OF DISPERSION MATRICES

BOX M =	194.13399	
F WITH (84,15649) DF =	2.21830, P =	.000 (APPROX.)
CHI-SQUARE WITH 84 DF -	186.44087, P =	.000 (APPROX.)

$H_0 : \sigma^2_{11} = \sigma^2_{12} = \sigma^2_{21} = \sigma^2_{22}$ REJECT H_0

For each of the correlation matrices, there is a corresponding covariance matrix. Box's M shows that the correlation matrices and covariance matrices are not equal. Therefore, the test that the variance/covariance matrices are equal has been rejected at the .05 level. The major discrepancy here is the fact that the N's are quite different between groups 1 and 2. With equal N's in the cells, homogeneity of variance could have resulted. In view of this, we can assume that the variance/covariance matrices of the four cells are significantly different in terms of the overall significance. Past research has found that the assumption of homogeneity of variance-covariance matrices is not critical and that further analysis may be performed.

The cell means and standard deviations are listed for each of the seven scales and for the high risk and low risk groups (See Table XXIII).

The cell means of Scale 1, for both of the low risk groups, appear to be significantly higher than the high risk group means. The low risk means for Scale 2 are slightly higher than the high risk means. They are not to be considered significant.

The reverse is true in Scale 3 where the means for the high risk groups, 1 and 2, are both significantly higher than the low risk means.

There appears to be some significance here. (See Appendix X).

Scale 4, low risk means are slightly higher for the low risk groups 1 and 2. There appears to be low significance here between the high risk and low risk groups. The same can be said for Scale 5 where the low risk means are slightly elevated over the high risk mean values. Similiar results are reported for Scales 6 and 7 where the differences are small.

In Scales 2, 3 and 7 all of the low risk means were below the average mean for the entire sample. The means for the low risk group, overall, were higher than the high risk group means. The safety climate inventory items which were adminstered were similar for all groups. the effect of PATHO (RISK VARIABLE) or Multivariate Tests of Significance were rejected at the .05 level of significance.

TABLE XXVI

Test Name	Value	Aprox. F	H of F	Error DF	Sign of F
Pillais	.197	11.86	7.00	337.0	.000
Hotellings	.246	11.86	7.00	337.0	.000
Wilks	.802	11.86	7.00	337.0	.000
Roys	.197				

HO: M1. = M2. P = .000 (Risk Var.)
2 2

Reject H_0 at $\alpha = .05$

TABLE XXVII

The effect on accident status. Multivariate Tests of Significance.

Test Name	Value	Aprox. F	H of F	Error DF	Sign of F
Pillais	.050	2.54	7.00	337.00	.014
Hotellings	.052	2.54	7.00	337.00	.014
Wilks	.949	2.54	7.00	337.00	.014
Roys	.050				

HO: M1. = M2. P = .014 (Accident Status)
2 2
Reject HO at α .05
Reject HO
(Variable)

The Multivariate test for interaction indicates the test for interaction is not significant.

TABLE XXVIII

EFFECT ACSTATUS BY PATHO

MULTIVARIATE TESTS OF SIGNIFIANCE (S - 1, M = 2 1/2, N = 167 1/2)

Test Name	Value	Aprox. F	H of F	Error DF	Sign of F
Pillais	.01375	.67120	7.00	337.00	.696
Hotellings	.01394	.67120	7.00	337.00	.696
Wilks	.98625	.67120	7.00	337.00	.696
Roys	.01375				

TABLE XXIX

UNIVARIATE F TESTS (RISK)

UNIVARIATE F-TESTS WITH (21,343) D.F.

VARIABLE	HYPOTH. SS	ERROR SS	HYPOTH. MS	ERROR MS	F	SIG. OF F
SCALE 1	3649.53788	21261.42407	3649.53788	61.98666	58.87618	.000
SCALE 2	8.95682	6551.37160	8.95682	19.10021	.46894	.494
SCALE 3	633.79613	9416.53083	633.79613	27.45344	23.08622	.000
SCALE 4	127.88314	4835.52103	127.88314	14.09773	9.07119	.003
SCALE 5	213.87111	5501.69871	213.87111	16.03994	13.33366	.000
SCALE 6	9.43999	3680.98107	9.43999	10.73172	.87963	.349
SCALE 7	12.36096	4746.69105	12.36096	13.83875	.89321	.345

TABLE XXX

UNIVARIATE F TESTS (ACC. STATUS)

UNIVARIATE F- TESTS WITH (1,343) D.F.

VARIABLE	HYPOTH. SS	ERROR SS	HYPOTH. MS	ERROR MS	F	SIG. OF F
SCALE 1	567.03102	21261.42407	567.03102	61.98666	9.14763	.003
SCALE 2	15.46562	6551.37160	15.46562	19.10021	.80971	.369
SCALE 3	260.81610	9416.53083	260.81610	27.45344	9.50031	.002
SCALE 4	33.50293	4835.52103	33.50293	14.09773	2.37648	.124
SCALE 5	38.12935	5501.69871	38.12935	16.03994	2.37715	.124
SCALE 6	4.59554	3680.98107	4.59554	10.73172	.42822	.513
SCALE 7	28.22279	4746.69105	28.22279	13.83875	2.03940	.154

The univariate F-test showed that Scales 1, 3, 4 and 5 were significant as displayed in Table XXIX.

SCALE 1	HO: M,1.1 = M,2.1	Reject HO for Effect of Patho	.05 α
SCALE 2	HO: M,1.2 = M,2.2	Do not reject HO Effect of Patho	.05 α
SCALE 3	HO: M,1.3 = M,2.3	Reject HO for Effect of Patho	.05 α
SCALE 4	HO: M,1.4 = M,2.4	Reject HO for Effect of Patho	.05 α
SCALE 5	HO: M,1.5 = M,2.5	Reject HO for Effect of Patho	.05 α
SCALE 6	HO: M,1.6 = M,2.6	Do not reject HO Effect of Patho	.05 α
SCALE 7	HO: M,1.7 = M,2.7	Do not reject HO Effect of Patho	.05 α

PATHO = RISK VARIABLE

Scales 1, 3, 4 and 5 (dependent variables) were found to be significant for the risk groups 1 and 2. The others are not even close to being significant at the .05 level.

(Wilk's Lambda = .802 for the dimension reduction analysis. The eigenvalue for the risk variable is .246 and the Canonical correlation is .444. This means that 44.4% of the risk variance is attributed to Scales 1, 3, 4 and 5).

SCALE 1	HO: M,1.1 = M,2.1	Rejected HO for Effect of Acc Status	.05 α
SCALE 2	HO: M,1.2 = M,2.2	Do not Reject HO Effect of Acc Status	.05 α
SCALE 3	HO: M,1.3 = M,2.3	Reject HO Effect of Acc Status	.05 α

SCALE 4	HO: M,1.4 = M,2.4	Do not Reject HO Effect of Acc Status	.05 α
SCALE 5	HO: M,1.5 = M,2.5	Do not Reject HO Effect of Acc Status	.05 α
SCALE 6	HO: M,1.6 = M,2.6	Do not Reject HO Effect of Acc Status	.05 α
SCALE 7	HO: M,1.7 = M,2.7	Do not Reject HO Effect of Acc Status	.05 α

Here the Univariate F tests show that Scales 1 and 3 (dependent variables) are found to be significant for accident status groups 1 and 3. The others are not close to being significant at the .05 level.

The accident status eigenvalue is .052 and the canonical correlation is .224. This means that 22.4 percent of the accident status variables were accounted for in Scales 1 and 3. The other Scales were not significant.

FURTHER ANALYSIS

The initial step was to study the 50 items included in the Safety Climate Attitude Inventory. The 50 items in the test instrument were analyzed to determine why 12 of the 50 items discriminated significantly. In Table XXXI the items which discriminated significantly are listed below each of the five scales from which these 12 items were derived.

It should be noted here that none of the 12 discriminating items relates to Scale 2, (Effect of Safe Conduct on Promotion) and Scale 6, (Enforcement vs. Guidance).

Displayed in Table XXXII are the variables not included in the analysis after step 1. Scale 2 and 6 both have F's to enter less than

TABLE XXXI

RELATIONSHIP OF DISCRIMINATING ITEMS TO SCALES

SCALE 1	SCALE 3	SCALE 4	SCALE 5	SCALE 7
MANAGEMENT	RISK	TRAINING	STATUS-S.O.	SOCIAL STATUS
I7 - Training Worthy Investment	I34 - This Factory is Dangerous	I38 - Dangerour situation reported	I1 - Safety committee warning affects behavior	I19 - Safety belonging to safety committee
I21 - Manager views safety reg's seriously	I15 - Chance of accident large		I10 - Safety officer influence great	I45 - Employees self Evaluation important
I27 - Manager controls Hazards			I40 - Safety officer reg's considered	
I43 - Supervisor points out hazard				

TABLE XXXII

VARIABLE NOT IN ANALYSIS

VARIABLE	TOLERANCE	MINIMUM TOLERANCE	F TO ENTER	RAO'S V
SCALE 1	0.9636851	0.9636851	5.0288	14.10010
SCALE 2	1.0000000	1.0000000	.79018	
SCALE 4	0.9993027	0.9993027	2.0337	11.01856
SCALE 5	0.9983282	0.9983282	2.6124	11.61396
SCALE 6	0.9991893	0.9991893	.53327	
SCALE 7	0.9953158	0.9953158	2.5981	11.59926

1.0. Prior to entering, a variable into the equation, F must equal 1.0 or greater. It was reported earlier in the study that Scale 3 had the largest F value (8.92) and Scale 1 had an F to enter of (5.02). In addition RAO's V is nil for both Scales 2 and 6. This explains why none of the variables entered under Scales 2 and 6 had any statistical significance.

The F values of the subsequent scales were: Scale 4 (F = 2.03); Scale 5(F = 2.6); and Scale 7 (F =2.59) (Table XXXII).

Then, according to Fisher's Linear Discriminant Function, Scale 3 had a classification function coefficient of .999 resulting in the highest scale predictability for the unclassified member in a group. This was followed by Scale 1 which resulted in a classification function coefficient of .707. Using both of these values, group membership can be predicted for an unclassified member of a group. However, it must be a member of a group. However, it must be remembered that Scales 1 and 3 account for only 19.8 percent of the total variability and the total prediction of group membership in reported at 57.99% accuracy.

In conclusion, the Scales, the dependent variable in this study, are based on the fact the P = .1259 and the percent of "grouped" cases correctly classified, means that predictability is low using scale scores.

The item results are reported in Table XXXIX labeled Item Intercorrelation. Indicated are levels of intercorrelation between Scales 1, 5 and 6 based on using all 50 items for item correlation, with the 12 items of high predictibility. (Table XXXIX) The Pooled Within-Groups Correlation matrix was used to determine intercorrelation of items as well as intracorrelation, which occured is Scales 3 and 7. A minimum correlation level of .30 was established. It is possible to make some comparisons. One major finding is that Scale 1 is highly intercorrelated with Scale 5. The intercorrelation matrix shows that the following items in Scale 1 are intercorrelated with Scale 5 (I_{10}, I_{17}, I_3, I_{40}). Scale 5 items intercorrated with two of the three Scale 1 high predictability items which are: (I_{11}, I_{21}, I_{24}, I_{25}, I_{27}, I_{36} & I_{43}). In analyzing item identifications, one can empirically note the close management attitude correlations between the variables (items) in Scales 1 and 5.

The conclusion which can be drawn here is that Scale 1 (management attitude) and Scale 5 (Status of Safety Officer) would logically fit together, because in all organizations studied, the safety officer was part of management. The analysis of the intercorrelation matrix concerning Scales 1 and 5 support this theory. In fact, the effect of Scale 1 (Management Attitude) can probably be extended to include all seven scales to some degree. The results of the 50 item analysis is more valuable than the outcome of the scale scores. Another conclusion is that the TOTAL SCALE, should be used because of the increased effectiveness of measuring in seven different areas simultaneously. It is the total scale which discriminates. An analysis including all 50 items could be accomplished through direct solution. This procedure will increase the percentage of predictability, possibly to as high as 85 percent, combining 50 items plus the 7 scales.

Scale three (Risk Level) is composed of two items of high predictability (I_{15}, I_{34}) which intracorrelate with items (I_{22}, & I_{26})

with a correlation of .43. The fact that the two highly predictive items (I_{15}, I_{34}) plus the two intracorrelative items (I_{22}, I_{26}) with correlations of .43 within Scale 3, resulted in the F ratio of 8.92,the highest of all seven scales. This is an example of multicolinearity or combined intracorrelation. In this present study, analysis is necessary of both "inter" and "intra" correlation, the latter occuring in Scales 3 and 7.

Scale 6, (Enforcement vs. Guidance) which was not included as a discriminating scale, consisted of a number of items correlating with Scale 1 (Management Attitude). Again, it can be concluded that the management scale has many overiding implictions on the other scales.

In studying the correlation matrix, high positive correlations were found in scales 1 and 3; whereas, moderate to low correlations resulted in Scales 4 and 5. It is interesting to note that all correlations in Scale 7 were insignificant--below .30.

It can also be concluded that some of the Scale structures are more significant than others because of less error, a larger sampling and increased variability. When numerous means are related to one another, such as occured in Scale 3, parameters are formed.

Based on the forgoing results, it is believed that by using a broader base of all 7 scales and all 50 items, an instrument can be developed with high predicability of group membership (Cronbach's Alpha . 86).

The Cronbach coefficient alpha formula in this study has been applied to each subsurvey separately to estimate the reliability (in the internal-consistency sense) of the seven subsurveys. The Cronbach formula was applied to the set of reliability estimates, subsurvey intercorrelations, and subsurvey (Scale) variances to obtain an estimate of reliability of the total study. The reliability coefficients for Scale one which includes 12 inventory items (variables) has a standardized item alpha of .8649 which is the highest of the seven scales.

Hypothesis Two

' There is no similarity between factor structures of factor loadings in American industries versus those in Israel. Hypothesis two was tested using Zohar's original 40 item safety climate questionnaire. The data were factor analyzed with spssx utilizing principal component factor analysis with Varimax rotation. Table VI displays the 8 factors which were obtained. A comparison of factor structure and item loadings between The American (Loyola) and Zohar's Israeli (1980) study indicates significant differences.

The results depicted in Table VI shows the actual results of comparing Zohar's original 40 items with The American sample. Zohar's Israeli Study Table II lists the order of factors using Eigenvalue and percent of variance. This is followed by the raw number of items which loaded on each factor. Table III illustrating the American study, provides the same kind of information. Tables IV and V list the item numbers loading on each factor is Zohar's and the Loyola studies.

The next Table VI is comparison of factor's structure and item number similarities related to factors. Two major differences can be noted between the two studies by analyzing the table. First, there is a significant difference in the order of factor descriptions based on the principal-component factor analysis. Second, the item loadings on factors. (Zohar's No's.) 3 and 7 show differences. Items 1, 2, 4, 5, 6, and 7 have similar item loadings. However, major differences resulted in the ordering of the factor structures indicated by a comparison of eigenvalues. For example, in Zohar's factor structure, the perceived imporance of safety training was the highest, with an eigenvalue of (9.84). In The American study, the perceived management attitudes toward safety factor was in ranked number one with the eigenvalue of (7.74). Number 2, in Zohar's study was the perceived management attitudes toward safety with an eigenvalue of (4.63). Second place in The American study was perceived status of the safety officer with an eigenvalue of (2.92). Zohar's number three factor was the perceived effects of safety conduct on promotion with an eigenvalue of (2.11). In the third place in The American study, was the perceived effects of safety conduct on social status with an eigenvalue of (2.11), perceived level of risk at workplace was number 4 in Zohar's study--eigenvalue of (2.34). The perceived effects of safety conduct on promotion was number 4 in The American study with an eigenvalue of (1.72). Zohar reported perceived effect of required work pace on safety as number 5--eigenvalue of (1.66), Number 5 in The American study was perceived level of risk in the workplace--eigenvalue (11.49). The perceived status of safety officer was 6 in Zohar's study--eigenvalue of (1.17). Number 6 in The American study was; perceived effects or required work pace as safety with an eigenvalue of (11.42). Seventh place in Zohar's study was perceived effects of safe conduct on social status--eigenvalue (1.07). Zohar's number one factor, perceived importance of safety training programs were

TABLE XXXIII

CONSTRUCT CHART

		$\bar{x}$			S.D.
Scale 1		1-42.31	Scale 1		1-8.66
		2-44.87			2-8.31
	Total	43.52		Total	8.58
Scale 2		1-17.07	Scale 2		1-4.47
		2-17.49			2-4.23
	Total	17.27		Total	4.35
Scale 3		1-23.01	Scale 3		1-5.06
		2-21.27			2-5.75
	Total	22.19		Total	5.46
Scale 4		1-21.53	Scale 4		1-3.97
		2-22.15			2-3.58
	Total	21.82		Total	3.80
Scale 5		1-15.41	Scale 5		1-3.90
		2-16.07			2-4.25
	Total	15.72		Total	4.08
Scale 6		1-18.14	Scale 6		1-3.43
		2-18.37			2-3.08
	Total	18.25		Total	3.26
Scale 7		1-23.40	Scale 7		1-3.93
		2-23.97			2-3.47
	Total	23.67		Total	3.72

N= 1-183
2-164

rated seventh in The American study--eigenvalues (1.26). Both Zohar's and the American study rated perceived status of a safety committee as number 8 eigenvalue--Zohar (.84); American (1.20).

In view of the above differences between Zohar's Israeli study and The American study the null hypothesis is not rejected. The null hypothesis stated that there is no similarity between factor structures of factor loadings in American industries versus those in Israel.

Summary

Many of the differences between Zohar's factor structures and those in the Loyola Study can be attributed to cultural differences between the two countries and major philosophical differences between labor unions in America and Isreal. Dov Kahana, a business executive with Cambridge Associates, 9933 Lawlor, Skokie, Illinois, had 25 years of work related experiences in several Israeli industrial organizations. He pointed out major differences between Israeli labor unions and those in the U.S.. The major Israeli labor union is called Hestardruth. It covers about Seventy percent of the blue collar workers. This Israeli Union has different branches, i.e. teachers, welders, airline pilots etc.

The Hestardruth provides a wide range of benefits and which are administered by the Israeli government. The union provides much protection for the employee. In order to discharge a blue collar worker, after one year of service, is extremely difficult because the Israeli worker is actually tenured following his/her first year of employment.

Dov Kahana pointed out that the union is very democratic, and elections are conducted annually; whereas, in most American labor organizations, those in power, are appointed by a few union leaders who control the union, e.g., Teamsters, UAW etc.

The fact that most Israeli workers enjoy a great deal more security from the threat of being fired, will affect their psychological attitude. The fact that Zohar's number one factor was the employee's perceived importance of safety training programs can be related to the Israeli blue collar worker who doesn't need to fear the threat of being laid off, and he/she perceives safety training as being highly important in preventing a serious accident to him/her individually. Evidently, Israeli workers perceive safety training as a basic need. This can be related to Maslow's prepotency theory which means that higher needs of workers cannot emerge until lower ones have first been satisfied. In the case of the typical Israeli worker, because of union protection and tenure, the lower level need of job secutriy has been satisfied. Maslow's Theory of human behavior, on the basis of hierarchy of needs, can be related to improving and developing a healthy psychological safety climate.

In contrast, American workers perceive management, including the company's chief executive officer, safety officer and/or supervisor, as the major components of an industrial organization's safety climate. Based on the American factor structure, in this study, employees perceived top "management commitment" to safety as the main individual worker's psychological perception toward anyone in management who U.S. workers perceived to share the major responsibility for safety.

The influence of U.S. labor unions on workers is important because of the apparent split between labor and management on safety issues. If we analyze the safety climate inventory item on management attitude, it is stated as a question; how do you perceive management attitude toward safety? The nature of this question as well as many others in the inventory will, no doubt, produce certain abstractions. We are dealing with perceptual concepts which lend themselves to a certain degree of inference and individual workers may express feelings in totally different ways. Another thing to consider, is the level of effect that certain labor organizational practices have on an individual's perceptions toward management, promotion etc.

Another matter related by Israeli employees in Zohar's study, is that of morale. According to Kahana, the morale of typical Israeli workers is quite low. Although, the Israeli employee appears to have more job security than his or her counterpart in the U.S., they also have an excellent social security plan and complete medical coverage paid by the state.

After discussing this present study with Dov Kahana, it was possible to analyze why the typical Israeli worker perceived safety training as being more important then management attitude. The Israeli worker ranked his/her perception of the safety officer, effects of safe conduct on social status and the status of the safety committee as factors 6, 7, and 8. In contrast the American worker rated the perceived status of the safety officer as factor 2 and the perceived effects of safety conduct on social status as factor number 3.

Since safety climate is based on personal perceptions and affects on attitude, it can be instrumental in developing the employee's safety behavior. In making the comparison between Israeli and American workers we need to consider organizational climate (high security vs low security) which may affect employee behavior by; defining the stimuli which confront the employee, placing roadblocks on the freedom of choice of behavior, and/or rewarding and punishing behavior. Perceptions are influenced by abilities, values and personality traits, cultural differences, and labor organizational climate as they were perceived by the worker as well as his/her personal roles and/or goals, can be a major source of conflict.

TABLE XXXIV

LISTED BELOW ARE THE RELIABILITY COEFFICIENTS FOR THE SEVEN SCALES FROM HIGH TO LOW:

SCALE	STANDARDIZED ITEM ALPHA
1	.9649
5	.6855
2	.6742
4	.6582
3	.6255
7	.4874
6	.2823
N = 363	AVE. .6111

Scale 1 should be classified as having a strong positive Alpha Coefficient; whereas, Scales 5, 2, 4, and 3 would be rated as having a moderate positive reliability coefficient. Scale 7 and 6 have weak reliability coefficients on the positive side. The average Alpha for all seven scales is .6111 or moderately positive.

TABLE XXXV

SPEARMAN BROWN SPLIT-HALF

RELIABILITY ANALYSIS

	MEAN	STD DEV	CASES
ITEM 50	2.4628	1.2704	363.0

OF CASES = 363.0

STATISTICS FOR	MEAN	VARIANCE	STD DEV	VARIABLES
PART 1	81.5455	146.1160	12.0878	25
PART 2	80.8843	100.4949	10.0247	25
SCALE	162.4298	406.4004	20.1594	50

ITEM MEANS	MEAN	MINIMUM	MAXIMUM	RANGE	MAX/MIN	VARIANCE
PART 1	3.2618	1.7052	3.8981	2.1928	2.2859	.2963
PART 2	3.2354	2.3774	4.0275	1.6941	1.6941	.2254
SCALE	3.2486	1.7052	4.0275	2.3223	22.3619	.2557

RELIABILITY COEFFICIENTS 50 ITEMS

CORRELATION BETWEEN FORMS = .6593 EQUAL LENGTH SPEARMAN-BROWN = .7947

GUTTMAN SPLIT-HALF = .7864 UNEQUAL-LENGTH SPEARMAN-BROWN = .7947

ALPHA FOR PART 1 = .7831 ALPHA FOR PART 2 = .7256

25 ITEMS IN PART 1 25 ITEMS IN PART 2

TABLE XXXVI

CRONBACH'S ALPHA COEFFICIENT

	MEAN	STD DEV	CASES
ITEM 50	2.4628	1.2704	363.0

STATISTICS FOR SCALE	MEAN	VARIANCE	STD DEV	VARIABLES
	162.4298	406.4004	20.1594	50

ITEM MEANS	MEAN	MINIMUM	MAXIMUM	RANGE	MAX/MIN	VARIANCE
	3.2486	1.7052	4.0275	2.3223	2.3619	.2557

RELIABILITY COEFFICIENTS 50 ITEMS

ALPHA = .8528 STANDARDIZED ITEM ALPHA = .8599

Spearman-Brown split-half reliability coefficient on items 1 through 50 resulted in an Alpha for part 1 of .7831 and an Alpha for part 2 of .7256 compared with Cronbach's Alpha Coefficient of .8599. Both of these reliability coefficients indicate a high reliability coefficient. Furthermore, in an internal-consistency sense, the total reliability of the 50 inventory items is high.

TABLE XXXVII

CHRONBACH'S ALPHA/HOLMES SURVEY STUDY

RELIABILITY ANALYSIS-SCALE (ONE)

	MEAN	STD DEV	CASES
ITEM 5	3.7741	1.1485	363.0
ITEM 6	3.5510	1.2189	363.0
ITEM 7	3.8981	1.0658	363.0
ITEM 11	3.6364	1.2077	363.0
ITEM 14	3.3278	1.1776	363.0
ITEM 18	3.4766	1.2015	363.0
ITEM 21	3.4738	1.0360	363.0
ITEM 24	3.2645	1.1474	363.0
ITEM 25	3.7796	1.0517	363.0
ITEM 27	3.4959	1.0934	363.0
ITEM 36	3.5840	1.0850	363.0
ITEM 43	4.0275	.9069	363.0

N = 363.0

STATISTICS FOR	MEAN	VARIANCE	STD DEV	VARIABLES
SCALE	43.2893	72.9023	8.5383	12

ITEM MEANS	MEAN	MINIMUM	MAXIMUM	RANGE	MAX/MIN	VARIANCE
	3.6074	3.2645	4.0275	.7631	1.2338	.0515

RELIABILITY COEFFICIENTS 12 ITEMS

ALPHA = STANDARDIZED ITEM ALPHA = .9649

TABLE XXXVIII

RELIABILITY ANALYSIS - SCALE (TWO)

	MEAN	STD DEV	CASES
ITEM 4	2.9201	1.4666	363.0
ITEM 29	3.3361	1.0232	363.0
ITEM 30	2.5840	1.1421	363.0
ITEM 33	2.5647	1.1649	363.0
ITEM 35	3.0413	1.0673	363.0
ITEM 39	2.8815	1.1024	363.0

N = 363.0

STATISTICS FOR	MEAN	VARIANCE	STD DEV	VARIABLES
SCALE	17.3278	18.7624	4.3316	6

ITEM MEANS	MEAN	MINIMUM	MAXIMUM	RANGE	MAX/MIN	VARIANCE
	2.8880	2.5647	3.3361	.7713	1.3008	.0845

RELIABILITY COEFFICIENTS 6 ITEMS

ALPHA = 3.6747 STANDARDIZED ITEM ALPHA = .6742

TABLE XXXIX

RELIABILITY ANALYSIS - SCALE (THREE)

	MEAN	STD DEV	CASES
ITEM 3	3.6860	1.3402	363.0
ITEM 9	2.8815	1.3865	363.0
ITEM 15	3.1956	1.2865	363.0
ITEM 16	1.7052	1.2933	363.0
ITEM 22	2.5702	1.1260	363.0
ITEM 26	3.1488	1.3044	363.0
ITEM 34	2.3774	1.3799	363.0
ITEM 37	2.8017	1.2828	363.0

N = 363.0

STATISTICS FOR	MEAN	VARIANCE	STD DEV	VARIABLES
SCALE	22.3664	29.6251	5.4429	8

ITEM MEANS	MEAN	MINIMUM	MAXIMUM	RANGE	MAX/MIN	VARIANCE
	2.7958	1.7052	3.6860	1.9807	2.1616	.3571

RELIABILITY COEFFICIENTS 8 ITEMS

ALPHA = .6195 STANDARDIZED ITEM ALPHA = .6255

TABLE XXXX

RELIABILITY ANALYSIS-SCALE (FOUR)

	MEAN	STD DEV	CASES
ITEM 8	3.7410	1.0869	363.0
ITEM 12	3.6667	1.2838	363.0
ITEM 28	3.6501	.9021	363.0
ITEM 31	3.8292	1.0238	363.0
ITEM 32	3.3196	.9846	363.0
ITEM 38	3.5289	1.0089	363.0

N = 363.0

STATISTICS FOR	MEAN	VARIANCE	STD DEV	VARIABLES
SCALE	21.7355	14.6315	3.8251	6

ITEM MEANS	MEAN	MINIMUM	MAXIMUM	RANGE	MAX/MIN	VARIANCE
	3.6226	3.3196	3.8292	.5096	1.1535	.0320

RELIABILITY COEFFICIENTS 6 ITEMS

ALPHA = .6523 STANDARDIZED ITEM ALPHA = .6582

TABLE XXXXI

RELIABILITY ANALYSIS-SCALE (FIVE)

	MEAN	STD DEV	CASES
ITEM 1	3.1240	1.2116	363.0
ITEM 10	3.1093	1.3755	363.0
ITEM 17	3.2617	1.2417	363.0
ITEM 23	2.8044	1.2204	363.0
ITEM 40	3.5565	.9513	363.0

N = 363.0

STATISTICS FOR MEAN VARIANCE STD DEV VARIABLES

ITEM MEANS	MEAN	MINIMUM	MAXIMUM	RANGE	MAX/MIN	VARIANCE
	3.1532	2.8044	3.5565	.7521	1.2682	.0787

RELIABILITY COEFFICIENTS 5 ITEMS

ALPHA = .6869 STANDARDIZED ITEM ALPHA = .6855

TABLE XXXXII

RELIABILITY ANALYSIS - SCALE (SIX)

	MEAN	STD DEV	CASES
ITEM 42	3.0992	1.0930	363.0
ITEM 44	3.7548	.9622	363.0
ITEM 47	2.7190	1.2585	363.0
ITEM 48	3.1873	1.1977	363.0
ITEM 49	3.0799	1.2311	363.0
ITEM 50	2.4628	1.2704	363.0

N = 363.0

STATISTICS FOR	MEAN	VARIANCE	STD DEV	VARIABLES
SCALE	18.3030	10.6483	3.2632	6

ITEM MEANS	MEAN	MIMIMUM	MAXIMUM	RANGE	MAX/MIN	VARIANCE
	3.0505	2.4628	3.7548	1.2920	1.5246	.1947

RELIABILITY COEFFICIENTS 6 ITEMS

ALPHA = 7 .2682 STANDARDIZED ITEM ALPHA = .2823

TABLE XXXXIII

RELIABILITY ANALYSIS-SCALE (SEVEN)

	MEAN	STD DEV	CASES
ITEM 1	3.1240	1.2116	363.0
ITEM 13	3.6942	1.0206	363.0
ITEM 19	2.0413	1.2771	363.0
ITEM 20	3.4463	1.0322	363.0
ITEM 41	3.1956	1.1213	363.0
ITEM 45	3.8953	.8311	363.0
ITEM 46	3.7631	1.0077	363.0

N = 363.0

STATISTICS FOR	MEAN	VARIANCE	STD DEV	VARIABLES
SCALE	23.1598	13.8142	3.7167	7

ITEM MEANS	MEAN	MINIMUM	MAXIMUM	RANGE	MAX/MIN	VARIANCE
	3.3085	2.0413	3.8953	1.8540	1.9082	.3952

RELIABILITY COEFFICIENTS 7 ITEMS

ALPHA = .4767 STANDARDIZED ITEM ALPHA = .4874

TABLE XXXXIV

REALIBILITY ANALYSIS TOTAL SCALE

	MEAN	STD DEV	CASES
ITEM 1	3.1240	1.2116	363.0
ITEM 2	3.6061	1.0599	363.0
ITEM 3	3.6860	1.3402	363.0
ITEM 4	2.9201	1.4666	363.0
ITEM 5	3.7741	1.1485	363.0
ITEM 6	3.5510	1.2189	363.0
ITEM 7	3.8981	1.0658	363.0
ITEM 8	3.7410	1.0869	363.0
ITEM 9	2.8815	1.3865	363.0
ITEM 10	3.0193	1.2755	363.0
ITEM 11	3.6364	1.2077	363.0
ITEM 12	3.6667	1.2838	363.0
ITEM 13	3.6942	1.0206	363.0
ITEM 14	3.3278	1.1776	363.0
ITEM 15	3.1956	1.2865	363.0
ITEM 16	1.7052	1.2933	363.0
ITEM 17	3.2617	1.2417	363.0
ITEM 18	3.4766	1.2015	363.0
ITEM 19	2.0413	1.2771	363.0
ITEM 20	3.4463	1.0322	363.0
ITEM 21	3.4738	1.0360	363.0
ITEM 22	2.5702	1.1260	363.0
ITEM 23	2.8044	1.2204	363.0
ITEM 24	3.2645	1.1474	363.0
ITEM 25	3.7796	1.0517	363.0
ITEM 26	3.1488	1.3044	363.0
ITEM 27	3.4959	1.0934	363.0
ITEM 28	3.6501	.9021	363.0
ITEM 29	3.3361	1.0232	363.0
ITEM 30	2.5840	1.1421	363.0
ITEM 31	3.8292	1.0238	363.0
ITEM 32	3.3196	.9846	363.0
ITEM 33	2.5647	1.1649	363.0
ITEM 34	2.3774	1.3799	363.0
ITEM 35	3.0413	1.0673	363.0
ITEM 36	3.5840	1.0850	363.0
ITEM 37	2.8017	1.2828	363.0
ITEM 38	3.5289	1.0089	363.0
ITEM 39	2.8815	1.1024	363.0
ITEM 40	3.5565	.9513	363.0
ITEM 41	3.1956	1.1213	363.0
ITEM 42	3.0992	1.0930	363.0
ITEM 43	4.0275	.9069	363.0
ITEM 44	3.7548	.9622	363.0
ITEM 45	3.8953	.8311	363.0

	MEAN	STD DEV	CASES
ITEM 46	3.7631	1.0077	363.0
ITEM 47	2.7190	1.2585	363.0
ITEM 48	3.1873	1.1977	363.0
ITEM 49	3.0799	1.2311	363.0
ITEM 50			

CHAPTER V

SUMMARY AND DISCUSSION

The purpose of the present study was to detect differences between "safe" and "unsafe" workers and to ascertain similarities between factor structures of factor loadings in this study versus those in Zohar's Israeli 1980 study.

The hypotheses tested in the present study were stated as follows:

1. There is no significant difference between "safe" and "unsafe" workers.
    a. As defined by the item scale scores.
    b. As defined by all 50 items Zohar/Holmes Safety Climate Attitudinal Inventory, the evaluation instrument.
2. There is no similarity between factor structures of factor loadings in American industries versus those in Israel.

Hypothesis one, concerned with differences between "safe" and "unsafe" workers, was tested utilizing item scale scores. The results of the analysis indicated that there is an overall significant difference between the perception of "safe" and "unsafe" workers in four out of seven (subconstructs) scales tested. The use of discriminant analysis aided in determining seven scales (subconstructs) that are associated with the safeness/unsafeness variables. Significant differences between group means and standard deviations of the scale scores indicated differences in worker perceptions of management attitudes toward safety; perceived level of risk in the workplace; the perceived importance of safety training programs and the perceived status of the safety officer. Since the safety officer is part of the management team, the employee perceptions of Scale 1 (Management) and Scale 5 (Safety Officer) were highly correlated. This finding was to be expected.

Utilizing the Safety Climate Questionnaire containing Zohar's original 40 items, hypothesis two was tested. This resulted in significant differences between factor structures of factor loadings in this study versus Zohar's Israeli study. Most of these differences can be attributed to cultural differences between the two countries including a strong influence of labor unions in American industries causing an apparent split between labor and management on basis safety issues. These differences are reflected in this present study.

Reference was made to differences between Israeli and American labor organizations in Chapter 4. The Hestardruth, the major Israeli labor organization, covering 70 percent of all blue collar workers, provides a wide range of benefits for Israeli employees. An important assumption was that differences between Israeli and American labor unions accounted for many of the cultural variances referred to in this study. The foregoing is a summary of the major cultural patterns created by U.S./Israeli labor union differences.

1. The fact that 70 percent of the Israeli workers enjoy job security, comparable "to tenure", following one year of on the job experience, apparently causes the Israeli worker to perceive organizational safety climate differently from that of his/her U.S. counterpart. For example, Israeli workers perceived the value of safety training programs as being the

most important dimension in the work environment. In contrast U.S. workers rated "management attitude toward safety" as the number one dimension.

This finding has some significant implications. The fact that the Israeli worker appears to have more job security, he/she perceives job safety training as being of more value than "perceived management attitudes toward safety." In other words, the typical Israeli worker perceives safety training as a higher basic need than management attitude. Maslow's prepotency theory has some implications here, the assumption that higher level needs of workers cannot emerge until lower ones such as job security have first been satisfied should be considered. Because of union protection and "tenure", the lower level need of job security has apparently been satisfied in the Israeli worker. This researcher theorizes that Maslow's theory of human behavior, on the basis of hierarchy of needs, can be directly related to analyzing and evaluating organizational safety climate.

2. Other significant differences in Israeli worker perceptions and those of U.S. workers were perceptions of the following dimensions: perceived affects of the safety officer; effects of safe conduct on social status and the perceived status of the safety committee. Israeli workers ranked these dimensions 6, 7 and 8 respectively, in contrast, the U.S. workers ranked perceptions of the safety officer as dimension number 2; perceived effects of safe conduct on social dimension number 3 and the status of the safety committee as number 8.

It is theorized that the typical Israeli worker ranked such dimensions as perceived effects of the safety officer;

effects of safe conduct on social status and the status of the safety committee as having the least amount of weight based on perceptions of workers. Perceptions are influenced by the worker's value system, personality traits and cultural differences. The major differences in U.S. and Israeli worker rankings are assumed to be the result of the respective labor organizational climates in the two countries. In Israel, the Hestardruth provides much job security for the blue collar worker; excellent health benefits; union protection and tenure; plus an excellent worker's compensation program in the event of an accident. Based on these facts, most of the worker's lower level needs (Maslow) have been satisfied. Higher level needs such as belongingness needs, self-esteem and self-actualization can be satisfied only after basic physiologic and safety needs have been satisfied. Maslow construes the worker not as being pushed by drives; instead, the worker is pulled by the need to be fulfilled. The Israeli worker, no doubt, is influenced differently by his/her labor union organization then his/her counterpart in the U.S.

In contrast to Zohar's research results, American workers perceive management, including the organizations chief executive officer, safety officer and/or superviser, as important dimensions or components of an industrial organization's safety climate. Based on the principal component analysis and factor structure in this present study, the major dimension rated high by U.S. worker was their perception of "management attitudes toward safety." This perception was evident in worker ratings of management personnel generally, (e.g., supervisor, safety officer, safety committee). The most important component of safety was management; those individuals who were perceived to have the major responsibility for safety. The U.S. worker ranked "management attitudes" as number 1; perceived status of the safety officer was rated number 2 and the perceived effects of safe conduct on social status was rated as dimension number 3.

It is somewhat difficult to evaluate the U.S. worker's perceptions based on Maslow's scheme of satisfaction or striving for higher needs. The individual worker needs to be sufficiently gratified by his/her basic needs (e.g., physiologic, safety needs, love needs, etc.). Workers need to utilize their capabilities and they need to be motivated by basic values, (e.g., moral, ethical, religious aesthetic) for which they strive, and for the loyality to the organization for which they work. It is evident that Israeli and U.S. workers, in this study, expressed their feelings in totally different ways. Cultural differences and the level of effect that labor organizational practices had on U.S. worker's perceptions toward management were highlighted in this study. In contrast, the Isreali workers rated safety training, effects of safe conduct on promotion and perceived levels of risk in the work place or having the greatest effect on safety climate. Both U.S. and Israeli workers rated management attitude high. (U.S. (1); Israeli, (2). This researcher assumes that the differences between personal perceptions of U.S. and Israeli workers were conditioned much by labor organizational climate (e.g., high security vs. low security) which could affect employee perceptions of the work environment.

A main focus of this study was directed to the psychological factors involved with safety; more specifically, with individuals' perceptions of the environment around them. This concept, known as organizational climate, discussed in Chapters 1 & 2, can be useful in evaluating the success of ongoing programs and evaluation for future programing discussed later in this chapter. The approach used in the present study is particularly useful in occupational health and safety because of the effect that perceived worker attitudes have on safe performance.

Several previous studies have evaluated organizational climate and compared the results with results of safety inspections. They concluded overwhelmingly, that companies in which the organizational climate was favorable toward safety, ultimately were the companies that also had the best safety programs. Since climate is a personal perception and it affects attitude, it can be instrumental in fashioning the individual's safety behavior.

Organizational climate may affect behavior by; defining the stimuli which confront the individual, placing constraints on the freedom of choice of behavior, and/or rewarding and punishing behavior. (Forehand & Gilmer, 1964). Perceptions are influenced by abilities, values, and personality traits of the perceiver as well as his/her organizational roles. Values can be considered to be common to all people regardless of race, culture, nationality, or religion.

Applying the concept of organizational climate to industry helps to evaluate employees' perception of the importance that the company places on safe practices. The mean of individual perceptions reflects the safety climate of the given company. The information should include perceptions of management's attitudes toward safety and their perceptions of the relevance of safety in the general production process. Companies with high safety climate scores and successful safety programs tend to have strong management commitment to safety (Zohar, 1980) This is supported by the findings of this study.

Implications For Industry

In Chapter IV Table XXXI there is a list of 12 discriminating inventory items which are purported to have significantly high predictibility values. Thus 12 items are listed in Scales 1, 3. 4, 5, and 7. There are some definite applications here for industrial organizations which are presented in the foregoing analysis which proposes the development of employee classification instrument.

Scale one, management attitude, contained four of the items of high predictability. The four items are I_7 (Safety Training A Worthy Investment), I_{21} (Manager Views Safety Regulations Seriously), I_{27} (Manager Controls Hazards) and I_{43} (Important for supervisor to point out Hazards).

Differences can be noted in the Scale loadings. I_{27} had the highest scale loading of .75 followed by I_{21} with a Scale loading of .64; I_{43} had a loading of .59 and I_7 with a Scale loading of .35. Item 21 correlated with a total of eight items in Scales 1, 6 and 7; whereas, I_{21} correlated with a total of eight items in Scales 1, 6 and 7; followed by I_{27} which correlated with five items in Scales 1, 5 and 6. Item 7 correlated with only two items in Scale 5-3(Appendix V). Item 43 did not covary with any other scale item with correlations above .30.

The implications for industrial application of the four items of predictability under scale one are especially promising when analyzing the inventory items (I_7 , I_{21} , I_{27} , I_{43}) of high predictability. Furthermore, intercorrelation was observed with a total of 15 other inventory items contained in Scales 1, 5, 6 and 7. Scale 1 had the highest reliability coefficient alpha of .9649 plus the most number of items of predictability (See Table XXXVIII).

Scale 3 contained two items of predictability; I_{15} (This factory is dangerous) and I_{34} (Chance of accident large). I_{15} and I_{34} intercorrelated with items 22 and 26, both of which loaded on Scale 3.

Scale 4 (Safety Training) contained only one item of predictability. This inventory item was labelled I_{38} (Dangerous Situation Reported). It covaried with I_{40} which loaded on Scale 5.

Scale 7 included two discriminating items; I_{19} (Status-Belonging to Safety Committee) and I_{45} (Employees Self Evaluation Important). One of the major differences between Scale 7 and Scales 1, 3, 4, and 5 is that the Scale 7 item intercorrelation did not include any items having correlation levels above .30. A minimum factor loading level of .30 was established early in the study and it was used throughout the research as a minimum criterion for practical consideration.

Following an analysis of the 12 items of high predictability and items of intercorrelation, an existing new test instrument is proposed. Once constructed, it could be used by organizations to discriminate and predict employee behavior as being "safe" or "unsafe". In addition, to the 12 items of predictability, a total of 12 other inventory items with correlations of more than .30 could be included in the proposed test instrument for a total of 24 items. These predictability items could then be used for the purposes of categorizing employees into Group 1 (safe) or into Group 2 (Unsafe) classifications.

The proposed employee classification instrument could include the following items:

PREDICTABILITY ITEM	SCALE LOADING	SCALE	NO. CORRELATIVE ITEMS
I_7 Training Worthy Investment	.35	1	2
I_{21} Manager views Safety Regs Seriously	.64	1	8
I_{27} Manager Controls Hazards	.75	1	5
I_{43} Importance for Supervisor to Point out Hazards	.59	1	0
I_{34} Chance of Accident Large	.74	3	1
I_{15} This Factory Dangerous	---	3	1
I_{38} Dangerous Situation Reported	.42	4	1
I_1 Safety Committee Warning Affects Behavior	.68	5	2
I_{10} Safety Officer Influence Great	.51	5	8
I_{40} Safety Officer Issues Safety Regulation-Employees behave Accordingly	.42	5	1
I_{19} Status Belonging to Safety Committee	.65	7	0
I_{45} Employees Self Evaluation Important	.65	7	0

CORRELATIVE ITEMS

High/Predictability

CORRELATION ITEMS	ITEM LOADING	SCALE	PREDICTABILITY
I_{17} Safety Committee Positive Effect	.37	1, 5	I_{10}, I_{17}
I_{24} Safety Issues High Priority	.49	1, 5	I_{1}, I_{10}
I_{25} Accident Affects Reputation	.35	1	I_{10}
I_{36} Management Adopts New Ideas	.46	1, 5	I_{1}, I_{10}, I_{17}
I_{41} Workers Conduct Improves Social Status	.35	1	I_{21}
I_{42} Supervisor's Guidance over Enforcement	.30	1	I_{21}
I_{47} Atmosphere free Of Threat	.30	1	I_{27}
I_{48} Supervisor's Understanding	.33	1, 6	I_{27}, I_{43}
I_{49} Supervisor's Humanistic	.30	1, 6	I_{27}, I_{43}
I_{22} Matter ot Time Before Accident	.43	3	I_{15}
I_{26} Job Safety Problems Serious	.43	3	I_{34}
I_{11} MGMT/Increase $ for Safety	.43	5	I_{10}

Based on discriminate analysis which resulted in a high Alpha Coefficient (reliability estimate), the construction of a test instrument utilizing the items of high predictability and intercorrelative items is recommended. The instrument could be administered to employees for classification purposes. It could also be used to classify employees into "safe" or "unsafe" categories with a fairly high predictability value for group membership.

The proposed employee classification instrument could be one of the most important outcomes of this study. Further study of the test instrument is recommended to determine the full implications of such an evaluation instrument to industry.

Recommendations for Additional Research

1. The present study was limited to data of 425 workers from 11 industrial organizations located in Illinois and Wisconsin. Since the total sample was selected from industries located in the midwest, the results of the study may not be generalizable to industries located in other sections of the United States. This study should be replicated in other types of industries such as mining, construction, and agriculture where accident experience is high. Furthermore, this study should be conducted in other parts of the U.S. for purposes of determining external validity.
2. The fact that a study by Fleischman in 1953 found that workers adapt, not as they have been taught, but in a style to fit their work climate (the way in which their supervisor behaved)

suggest that this may be a major area of concern when a low organizational climate is diagnosed. By manipulating cues in a simulated work place one can create climates designed to produce behaviors such as high levels of power, affiliation, and achievement motivation (Litwin & Stringer, 1968). This may be accomplished by strengthening management commitment to safety. There are several ways in which to do this. Give safety matters high priority in safety meetings and in production scheduling (e.g., have management personnel at the V.P. level report on safety problems and proposed solutions at safety meetings). Support of the conviction that safety is an integral part of the production system and that accidents are signs of design faults in the system. Top Management support of decision and safety programs by safety supervisors is proposed. Place high emphasis on safety training with strong communication lines and frequent inspections by both personnel and management. Promote general environmental control and good housekeeping. Stabilize the work force with a lower turnover and increase in the average age of employees, and finally provide guidance and counseling to promote safety. This could be a major area of further research by changing or creating climates to produce behaviors under simulated conditions. Future research could be conducted on a before and after basis in selected industries with low organizational safety climates. The results of simulating over in these industries could then be studied.

3. In the present study, mostly union workers were included. Further research could be accomplished comparing an equal number of non-union and union workers on their perceptions toward the environment around them. Comparisons could then be made between union and non-union worker perceptions of selected "safe" and "unsafe" environmental conditions.
4. Future research could be focused on evaluating the proposed employee classification test instrument designed to discriminate between a safe employee versus an unsafe one. The results of the instrument could be cued to assign an employee to the most appropriate group and or job task based on his/her safety or unsafe classification. It could also assist companies in employee selection, hiring, and placement. The practical aspects such an instrument could be studied in selected industries prior to final publication and dissemination.
5. Conduct a similar study to this present one on a qualitative basis. Select a team of investigators who would spend time within an industry to collect demographic and qualitative data by interviewing workers and reading questionnaire items to randomly selected employees. The demographic data collected by interviewing of workers should provide more detailed and comprehensive data to be used for in-depth the analysis of "safe" and "unsafe" workers. Comparisons and contrasts could be made with results of the present study based on the outcomes of the qualitative study.

Summary

Since its infancy, safety management has been typically concerned with things such as, engineering, physical stress, chemical stress, and others. More recently, however, the focus has been switched to the psychological factors involved with safety, more specifically, with individuals' perceptions of the environment around them. This concept, known as organizational climate, can be useful in a variety of ways, including evaluating the success of ongoing programs as well as any need for future programs. This approach is particularly useful in safety because of the great effect that attitudes have been shown to have on safe performance.

The concept of organizational climate when applied to safety can be a valuable tool for evaluation of current safety programs as well as determining needs for changes in the future.

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APPENDIX I

Performance Sites

Organization	SIC	Type	Contact person	# of Employees
Schneider Transportation Inc. P.O. Box 2298 Green Bay, WI 54306	7219	Motor Transportation	Thomas A. Titzkowski	1700 Drivers
Safety-Kleen Corporation 777 Big Timber Road Elgin, IL 60120 (697-8460-Sandy)		Industrial Cleaning Products & Services	Sandra Latufzek	380
Ambrosia Chocolate Co. 1133 N. 5th St. Milwaukee, WI 53203	2066	Food Processing Plant (Chocolate Products)	Al Zipperer	350
City of Kenosha 625 52nd St. Kenosha, WI 53140	9111 9199	City Government (Safety Program)	Kenneth Horner	687
Signod Corporation 3600 W. Lake Avenue Glenview, IL 60025	3499	Packaging System (Steel & Plastic Strapping, Hand Tools & Machines)	Robert Peterson	3900
American Brass-Arco Metals 1420 63rd St. Kenosha, WI 43140	33	Copper & Copper Alloyed Brass Production	Thomas Rugg	650

Performance Sites (cont.)

Organization	SIC	Type	Contact Person	# of Employees
The Larsen Co. Green bay, WI	2030	Canning Company & Food Processing	Mike Mallman	450
The Larsen Co. Jones Avenue Fort Atkinson, WI 53538	1030	Canning Company & Food Processing	John Hein Safety Manager	450
Mercury Marine 1939 Pioneer Road Fond du Lac, WI 54935	3519	Foundry, Dir cast Heavy Machinery & Assembly	Tom Baumgartner Safety & Health Manager	5500
Milwaukee Metro- politan Sewerage District 735 Water Street Milwaukee, WI 53202	9111 9199	Waste Water Treatment	Ms. Judy Grzegorski	675
Weiler & Co. 214 S. 2nd Street Whitewater, WI 53190	3550	Fabrication of Comm- mercial Meat Grinders and Mixers	Rick Hendrickson Superintendent of Manufacturing	100

APPENDIX II

ZOHAR/HOLMES SAFETY CLIMATE ATTITUDE INVENTORY INSTRUCTIONS

This inventory is designed to find out what you think about job safety and other related issues in your workplace. Please describe the current situation and DO NOT describe what you think it ought to be. All you need to do is indicate how much you agree or disagree with each questionnaire item. In other words, how much it is true in your case.

In order to mark your response, all you have to do is circle the appropriate number. See the following example:

	highly disagree	disagree	not sure	agree	highly agree	not relevant
In this company every worker can do his job the way he thinks it ought to be done.	1	2	3	4	5	0

You can mark the category title "not relevant" when the sentence refers to things which do not exist at your workplace.

This inventory is absolutely anonymous and there is no way to identify you personally. We want you, therefore, to be completely honest and respond as you really think and feel. If for some reason you wish to withdraw from this study, you may do so at any time without any negative consequence.

Thank you very much for your cooperation.

APPENDIX III

THE ZOHAR/HOLMES SAFETY CLIMATE ATTITUDE INVENTORY

Company Name:

Questionnaire No.:

	highly disagree	disagree	not sure	agree	highly agree	not relevant
1. When a member of the safety committee approaches a worker and warns him, it really affects his behavior.	1	2	3	4	5	0
2. Workers who violate safety regulations aggravate their fellow workers even when no harm has resulted.	1	2	3	4	5	0
3. The risk level of my job concerns me quite a bit.	1	2	3	4	5	0

4. Workers who behave safely have a higher chance for promotion than those who don't.	1	2	3	4	5	0
5. I usually inform my supervisor about safety issues in this plant.	1	2	3	4	5	0
6. Our general manager is well informed about safety issues in this plant.	1	2	3	4	5	0
7. The investment of money and effort in safety training programs is a worthy investment because it improves workers' performance on the job.	1	2	3	4	5	0
8. The best guys in our department care about safety and						

	they want other workers to behave according to the regulations.	1	2	3	4	5	0
9.	Work under a premium system has nothing to do with accidents. There are simply safe workers and unsafe ones.	1	2	3	4	5	0
10.	The safety officer has much influence on what's happening in our factory.	1	2	3	4	5	0
11.	Plant management in this factory is willing to invest money and effort to improve the safety level in here.	1	2	3	4	5	0
12.	My safety training really helps me both in my work and at home.	1	2	3	4	5	0
13.	Reckless behavior results in a negative						

	evaluation of supervisors towards that worker.	1	2	3	4	5	0
14.	Our management is well informed about safety problems and it quickly acts to correct them.	1	2	3	4	5	0
15.	My chance for being involved in an accident is quite large.	1	2	3	4	5	0
16.	Because I am working under a premium system I do things so fast that I have no time to care for my safety.	1	2	3	4	5	0
17.	The safety committee in committee in our plant has a very positive effect on what is happening here.	1	2	3	4	5	0

18. Managers in this factory really care and try to reduce risk levels as much as possible.	1	2	3	4	5	0
19. I would like to become a member of our plant safety committee because it would give me more status.	1	2	3	4	5	0
20. When a worker violates safety regulations it has an adverse effect on his supervisor's evaluation of him even when no harm was caused.	1	2	3	4	5	0
21. Our managers view safety regulation violations very seriously even when they have resulted in no apparent damage.	1	2	3	4	5	0

22. I am sure it is only a matter of time for me to get involved in an accident.	1	2	3	4	5	0
23. When the safety officer has a negative opinion of someone, it affects his supervisor's evaluation.	1	2	3	4	5	0
24. I think safety issues are assigned high priority in management meetings.	1	2	3	4	5	0
25. The efforts invested in organizing safety training programs really pay back to the company.	1	2	3	4	5	0

26. The safety problems in my job are very serious.	1	2	3	4	5	0
27. When a manager realizes that a hazardous situation has been found, he immediately attempts to put it under control.	1	2	3	4	5	0
28. Workers work safely try to emphasize it and make sure others appreciate it.	1	2	3	4	5	0
29. Workers who take safety training courses are less involved in accidents than those who don't.	1	2	3	4	5	0
30. One of the main factors affecting workers' evaluation for promotion is whether they were involved in an						

	accidents.	1	2	3	4	5	0
31.	Workers who use personal protective equipment are not considered to be cowards but rather good and tidy workers.	1	2	3	4	5	0
32.	Department managers usually remember who were involved in an accident and take it into consideration.	1	2	3	4	5	0
33.	Workers who take safety training courses have a better chance for promotion than those who don't.	1	2	3	4	5	0
34.	Compared to other factories, I think this one is rather dangerous.	1	2	3	4	5	0
35.	Being involved in an accident has						

	an adverse effect on the worker's reputation.	1	2	3	4	5	0
36.	Plant management in this factory is always willing to adopt new ideas for improving the safety level.	1	2	3	4	5	0
37.	Workers who don't work under a premium system can work more carefully.	1	2	3	4	5	0
38.	When a worker confronts a danger-ous situations in his work environment he reports it to the safety officer.	1	2	3	4	5	0
39.	Workers who take safety training courses are doing a better job than those who don't.	1	2	3	4	5	0
40.	When the safety officer issues						

	a safety regulation, we take it into consideration and behave accordingly.	1	2	3	4	5	0
41.	I feel that a worker's safe conduct will improve his/her social status among other employees.	1	2	3	4	5	0
42.	It is my opinion that supervisor guidance in safe practices is more important than the enforcement of safety rules.	1	2	3	4	5	0
43.	It is important for the safety supervisor to point out hazards which could cause painful injury.	1	2	3	4	5	0
44.	It is my feeling that counseling by supervisors						

is more effective than punishment or reprimand when it concerns safety motives. 1 2 3 4 5 0

45. Employees need to be encouraged to evaluate themselves in relation to efficiency, productivity and safety perhaps even more than they need evaluation by their supervisors. 1 2 3 4 5 0

46. Understanding and coping with the feelings of others is just as important as learning facts, safety rules and operational skills. 1 2 3 4 5 0

47. The working atmosphere in my company is free of threat,

	pressure and excessive competition.	1	2	3	4	5	0
48.	Our supervisors are normally understanding and they help to foster an atmosphere that is genuine, open and sincere.	1	2	3	4	5	0
49.	My supervisors are understanding and I feel they can put themselves in the place of workers such as myself.	1	2	3	4	5	0
50.	Most of the time I am made to feel like a lower class citizen by my supervisor.	1	2	3	4	5	0
51.	As an employee, I consider myself to be self directive and assertive, wanting to help my						

	fellow workers and I want to make a contribution to the company.	1	2	3	4	5	0
52.	There is a need for a program to change safety behavior and attitudes in our organization starting with top management.	1	2	3	4	5	0
53.	To merely point out the accidents cost the company money does not motivate me or my fellow workers to work safely.	1	2	3	4	5	0
54.	The main reason why I work safely at all times is that my family would suffer if I were injured.	1	2	3	4	5	0

55. Please fill in the following demographic data (if you feel that any of these data may identify you and you wish to remain anaymous, leave it

blank):

a. Department:

b. Job Title:

c. Age:

d. Sex: Male ; Female

e. Marital status: Single ; Married

f. No. of years in this company:

g. No. of years in your present job:

56. In your opinion, what is the most important factor affecting the safety level of this plant?

57. Do you have any other comments which you wish to make, either about this questionnaire or any other safety-related issues? Please use the back of this page.

Thank you!

APPENDIX IV

Discriminant Analysis on Groups Defined by No Accident Status (Group 1) and Accident Status (Group 2)

Mean and Standard Deviation of Inventory Item

	$\overline{x}$	SD
ITEM 1	1-3.13 2-3.11 Total 3.12	1-1.14 2-1.27 Total 1.20
ITEM 2	1-3.54 2-3.73 Total 3.63	1-1.05 2-1.01 Total
ITEM 3	1-3.69 2-3.70 Total 2.70	1-1.34 2-1.33 Total 1.33
ITEM 4	1-2.79 2-3.03 Total 2.90	1-1.43 2-1.49 Total 1.46
ITEM 5	1-3.74 2-3.87 Total 3.80	1-1.18 2-1.07 Total 1.13
ITEM 6	1-3.47 2-3.61 Total 3.54	1-1.21 2-1.23 Total 1.22
ITEM 7	1-3.78 2-4.07 Total 3.91	1-1.09 2-0.96 Total 1.04
ITEM 8	1-3.69 2-3.82	1-1.01 2-1.13 Total 1.07
ITEM 9	1-2.91 2-2.79 Total 2.85	1-1.35 2-1.42 Total 1.38
ITEM 10	1-2.80 2-3.20 Total 2.99	1-1.34 2-1.38 Total 1.37

ITEM 11	1-3.50	1-1.23
	2-3.79	2-1.16
	Total 3.64	Total 1.20
ITEM 12	1-3.55	1-1.31
	2-3.79	2-1.25
	Total 3.67	Total 1.28
ITEM 13	1-3.68	1-0.95
	2-3.76	2-1.16
	Total 3.64	Total 1.20
ITEM 14	1-3.18	1-1.16
	2-3.53	2-1.14
	Total 3.34	Total 1.17
ITEM 15	1-3.32	1-1.23
	2-3.00	2-1.34
	Total 3.17	Total 1.29
ITEM 16	1-1.71	1-1.20
	2-1.53	2-1.20
	Total 1.63	Total 1.25
ITEM 17	1-3.11	1-1.20
	2-3.41	2-1.26
	Total 3.25	Total 1.23
ITEM 18	1-3.36	1-1.19
	2-3.65	2-1.16
	Total 3.49	Total 1.18
ITEM 19	1-2.04	1-1.17
	2-1.84	2-1.26
	Total 1.95	Total 1.21
ITEM 20	1-3.35	1-1.05
	2-3.53	2-0.94
	Total 3.44	Total 1.00
ITEM 21	1-3.30	1-1.08
	2-3.67	2-0.91
	Total 3.47	Total 1.02
ITEM 22	1-2.69	1-1.13
	2-2.36	2-1.07
	Total 2.53	Total 1.11

ITEM 23	1-2.82	1-1.20
	2-2.73	2-1.24
	Total 2.78	Total 1.22
ITEM 24	1-3.15	1-1.20
	2-3.40	2-1.04
	Total 3.27	Total 1.13
ITEM 25	1-3.73	1-1.09
	2-3.90	2-0.97
	Total 3.81	Total 1.04
ITEM 26	1-3.28	1-1.23
	2-3.00	2-1.36
	Total 3.14	Total 1.30
ITEM 27	1-3.42	1-1.09
	2-3.61	2-1.08
	Total 3.51	Total 1.09
ITEM 28	1-3.64	1-0.94
	2-3.67	2-0.82
	Total 3.65	Total 0.88
ITEM 29	1-3.28	1-1.07
	2-3.35	2-0.94
	Total 3.32	Total 1.01
ITEM 30	1-2.54	1-1.20
	2-2.60	2-1.05
	Total 2.57	Total 1.13
ITEM 31	1-3.83	1-1.00
	2-3.87	2-1.04
	Total 3.85	Total 1.02
ITEM 32	1-3.33	1-0.94
	2-3.34	2-1.00
	Total 3.33	Total 0.97
ITEM 33	1-2.50	1-1.13
	2-2.57	2-1.19
	Total 2.53	Total 1.16
ITEM 34	1-2.56	1-1.36
	2-2.10	2-1.35
	Total 2.35	Total 1.37

ITEM 35	1-3.04	1-1.04
	2-3.03	2-1.07
	Total 3.03	Total 1.05
ITEM 36	1-3.54	1-1.09
	2-3.68	2-1.06
	Total 3.61	Total 1.08
ITEM 37	1-2.81	1-1.23
	2-2.76	2-1.32
	Total 2.78	Total 1.27
ITEM 38	1-3.46	1-0.99
	2-3.64	2-0.94
	Total 3.54	Total 0.97
ITEM 39	1-2.89	1-1.11
	2-2.89	2-1.03
	Total 2.89	Total 1.07
ITEM 40	1-3.53	1-0.96
	2-3.60	2-0.93
	Total 3.57	Total 0.95
ITEM 41	1-3.15	1-1.16
	2-3.25	2-1.06
	Total 3.20	Total 1.11
ITEM 42	1-3.10	1-1.08
	2-3.05	2-1.12
	Total 3.08	Total 1.10
ITEM 43	1-4.09	1-0.84
	2-4.04	2-0.86
	Total 4.07	Total
ITEM 44	1-3.79	1-0.97
	2-3.77	2-0.91
	Total 3.78	Total 0.94
ITEM 45	1-3.84	1-0.86
	2-4.00	2-0.74
	Total 3.92	Total 0.81
ITEM 46	1-3.77	1-1.07
	2-3.82	2-0.86
	Total 3.80	Total 0.98

ITEM 47	1-2.57 2-2.81 Total 2.68	1-1.25 2-1.25 Total 1.25
ITEM 48	1-3.08 2-3.30 Total 3.18	1-1.21 2-1.17 Total 1.20
ITEM 49	1-3.00 2-3.14 Total 3.06	1-1.25 2-1.22 Total 1.24
ITEM 50	1-2.58 2-2.28 Total 2.44	1-1.28 2-1.21 Total 1.26

Number of Cases

No Accident Group 1	183 cases
Accident Group 2	164 cases
	Total 347 cases

APPENDIX V

HIGH PREDICTABILITY ITEM INTERCORRELATION

SCALE	SCALE LABELS	ITEM COMPOSITION	SCALE LOADING	ITEM I.D.	SCALE	CORRELATIVE ITEMS	CORRELATION	CORRELATION ITEM IDENTIFIERS
1	Management Attitude	I_7	.35	Training Worthy Investment	5	I_{10}	.30	Safety Officer Influence Great
						I_{17}	.37	Safety Committee Positive
		I_{21}	.64	Manager Views Safety Reg's Seriously	1	I_{24}	.49	Safety Issues High Priority
					1	I_{25}	.35	Accident Affects Reputation
					1	I_{27}	.48	Manager Controls Hazards
					1	I_{36}	.46	Management Adopts New Ideas
					7	I_{41}	.35	Workers Conduct Improves Social Status
					6	I_{42}	.30	Supervisor Guidance Over Enforcement
					6	I_{48}	.33	Supervisor's Understanding
					6	I_{49}	.30	Supervisor's Humanistic
		I_{27}	.75	Manager Controls Hazards		I_{31}	.36	Workers Using PPE Not Cowards
					1	I_{36}	.53	Management Adopts New Safety Ideas
					5	I_{40}	.32	Safety Officer Regulation Considered
					6	I_{47}	.30	Atmosphere Free of Threat Etc.
					6	I_{48}	.45	Supervisor's Understanding
					6	I_{49}	.44	Supervisor's Humanistic
		I_{43}	.59	Important for Supervisor to Point out Hazards	(No Correlations More Than.30)			

HIGH PREDICTABILITY ITEM INTERCORRELATION (cont.)

SCALE	SCALE LABELS	ITEM COMPOSITION	SCALE LOADING	ITEM I.D.	SCALE	CORRELATIVE ITEMS	CORRELATION	CORRELATION ITEM IDENTIFIERS
3	Risk Level	I_{15}	.74	Chance of Accident Large	3	I_{22}	.49	Matter of Time Before Accident
		I_{34}	—	This Factory Dangerous	3	I_{26}	.68	Job Safety Problems Serious
4	Safety Training	I_{38}	.42	Dangerous Situation Reported	5	I_{40}	.39	Safety Officer Regulation Considered
5	Status of Safety Officer	I_1	.68	Safety Committee Warning Affects Behavior	5	I_{10}	.30	Safety Officer Influence Great
					5	I_{17}	.37	Safety Committee Positive Effect
		I_{10}		Safety Officer Influence Great	1	I_{11}	.43	Management Willing to Invest $
					1	I_{21}	.33	Managers' View Safety Reg's Seriously
					1	I_{24}	.40	Safety Issues High Priority
					1	I_{25}	.37	Training Investment $ Pays Off
					1	I_{27}	.34	Manager Control Hazards
					1	I_{36}	.37	Management Adopts New Ideas
					5	I_{40}	.42	Safety Officer Regulations Considered
		I_{40}	.42	Safety Officer Issues Saf. Reg.	1	I_{43}	.34	Important For Supervisor to Point out Hazards
7	Social Status	I_{19}	.65	Status Belonging to Safety Committee	(No Correlations More Than .30)			
		I_{45}	.65	Employee's Self Evaluation Important	(No Correlations More Than .30)			

APPENDIX VI

FACTOR COMBINATIONS

1. Item 4 loaded on both factors two (.61479) and factor seven (.33471). It was combined with both factors and placed with factor 2 because of the higher loading on F_2.
2. Item 35 loaded on factor two (.35461) and factor six (.47576). In this case both loadings were fairly low resulting in a logical placement with F_2.
3. Item 37 loaded on factor thirteen (.30169) and was placed logically under F_3.
4. Item 8 loaded on factor four (.40825) and factor one (.34755). Even though both loadings were fairly low, item 8 was logically placed under F_4.
5. Item 12 loaded on factor four (.43687) and factor one (.44614). Again, logic was used in this case to place item 12 with F_4.
6. Item 10 loaded on factor five (.51915) and factor one (.50856). There isn't much difference between the loadings, so the logical approach was used to place this item with F_5.
7. Item 17 loaded on factor five (.58510) and factor one (.49227). Item 17 was combined with factor five and seven, however, it was placed with F_5 because of the higher loading.
8. Item 23 loaded with factor five (.49289) and factor two (.37005). It was combined with factors five and one. Because of the significantly higher loading it was placed under F_5.
9. Item 40 loaded with factor one (.42670). Logic was used to determine the outcome here. Item 40 was placed under F_5.

FACTOR COMBINATIONS (cont.)

10. Item 42 loaded with factor thirteen (.70309). Therefore, factor 6 and factor 13 were combined to place item 42 logically under F_6.
11. Item 44 loaded with the combination of factor 13 and factor 6. The loading under factor 13 was .39855. Logically, it was placed under F_6.
12. Item 47 loaded with factor six (.41254) and factor two (.33321). Based on the higher loading, this item was placed under F_6.
13. Item 48 loaded with factor six (.56843) and factor one (.53490). The higher factor loading under factor 6 and logic were used in this case to place the item under F_6.
14. Item 49 loaded with factor six (.60483) and factor one (.50701). Based on the higher factor loading and logic this item was placed under F_6.
15. Item 2 loaded factor seven (.37053) and factor six (.33545) and F_8 (.40034). Even though factor seven and F_8 had the higher loadings, logic was used to placed item 2 under F_7.
16. Item 41 loaded with factor eight (.69090). Here the combination of factors 7 and 8 were used to place item 41 under F_7.
17. Item 46 loaded with factor ten (.68637). Logic was used here to place their item under F_7.

FACTOR COMBINATIONS (cont.)

18. Item 45 was loaded with factor ten (.65160). Logic was used to place item 45 under F_7.

19. Item 19 was placed with factor seven. The loading on factor eleven was (-.65215) Factor 11 was combined with factor 7. Then, logic was used here for placement and F_7.

20. Item 9 was placed under F_3 because of logic. It was combined with F_{12} where it had a loading of(.75955)

21. Item 43 had a loading of(.59271)on F_9. Factors 1 and 9 were combined and as a result of logic it was placed under F_1.

APPENDIX VII

COMPANY HIGH/LOW RISK SELECTION

	COMPANY	CONDITION	HIGH RISK	LOW RISK
1.	Schneider Trans., Inc	Trucking, Local & Long. Dist.	High Incidence Rate 10.41 per 100 Full time employers	
2.	Safety Kleen Corp	Industrial-Transportation	Local & Suburban Transit 12.74 incidence rate per 100 employees	
3.	Ambrosia-Chocolate	Food & Kindred Products	High incidence rate 9.46 per 100 Full time employees	
4.	City of Kenosha	Construction, cement, motor vehicles, lawn mowing etc	High incidence rate 10 + per 100 full time employees	
5.	Signode Corp.	Packaging, strapping, hand tools & machines (manufacturing) safety at corporate level		Low incidence rate below 3.0 per 100 employees
6.	American Brass-ARCO Metals	Copper & Copper Alloyed Brass production-foundry work-blasf furnance & basic steel products	High incidence rate 11.35 per 100 worker	
7.	The Larsen Co #1	Canning Co. & Food processing (Safety program at corporate level)		Low incidence rate below 3.0 per 100 employees
8.	The Larsen Co. #2	" " "		"

COMPANY HIGH/LOW RISK SELECTION (cont.)

COMPANY	CONDITION	HIGH RISK	LOW RISK
9. Mercury Marine	Foundry, Dir Cast, Heavy Machinery & Assembly	High Incidence rate 11.35 per 100 workers	
10. Milwaukee Metro	Engineering & Scientific Instruments-waste water meas. & control devices		Incidence rate less than 3.0 per 100 f/t employees.
11. Weiler Corp.	Fabrication of Comm. meat Grinders & Mixers (Fabricated metal products-special industry machinery)		Incidence rate less than 7 per 100 f/t workers

APPENDIX VIII

Definitions of Certain Terms Used in This Study

1. Accident is that occurrence in a sequence of events which usually produces unintended injury, death or property damage.
2. Disabling injury is an injury causing death, permanent disability, or any degree of temporary total disability beyond the day of the accident. (Used in this study to determine accident group).
3. High Risk company, determined by incidence rates of 10 + per 100 full time employees, e.g., (conditions) transportation, construction, tunneling, foundry work, blast furnances, basic steel work, heavy machinery & assembly.
4. Incidence rate, as defined by OSHA, is the number of injuries and/or illnesses or lost workdays per 100 full-time employees.
5. Industrial Accident Prevention, a term which refers to how accidents can be controlled in an organization, ranging from technical methods such as hazard recognition and control to the behavioral approaches through training and motivation.
6. Safe Worker, any worker in their study who has worked a period of 5 years without suffering a work related disabling injury accident.
7. Unsafe Worker, is one who has experienced one or more work related accidents within the past 5 years. The accident would cause the worker to be unable to perform duties or activities on one or more full calendar days following the day of the injury.
8. Workers' Compensensation insurance, is a compensated accident case determined to be work related and for which compensation was paid.

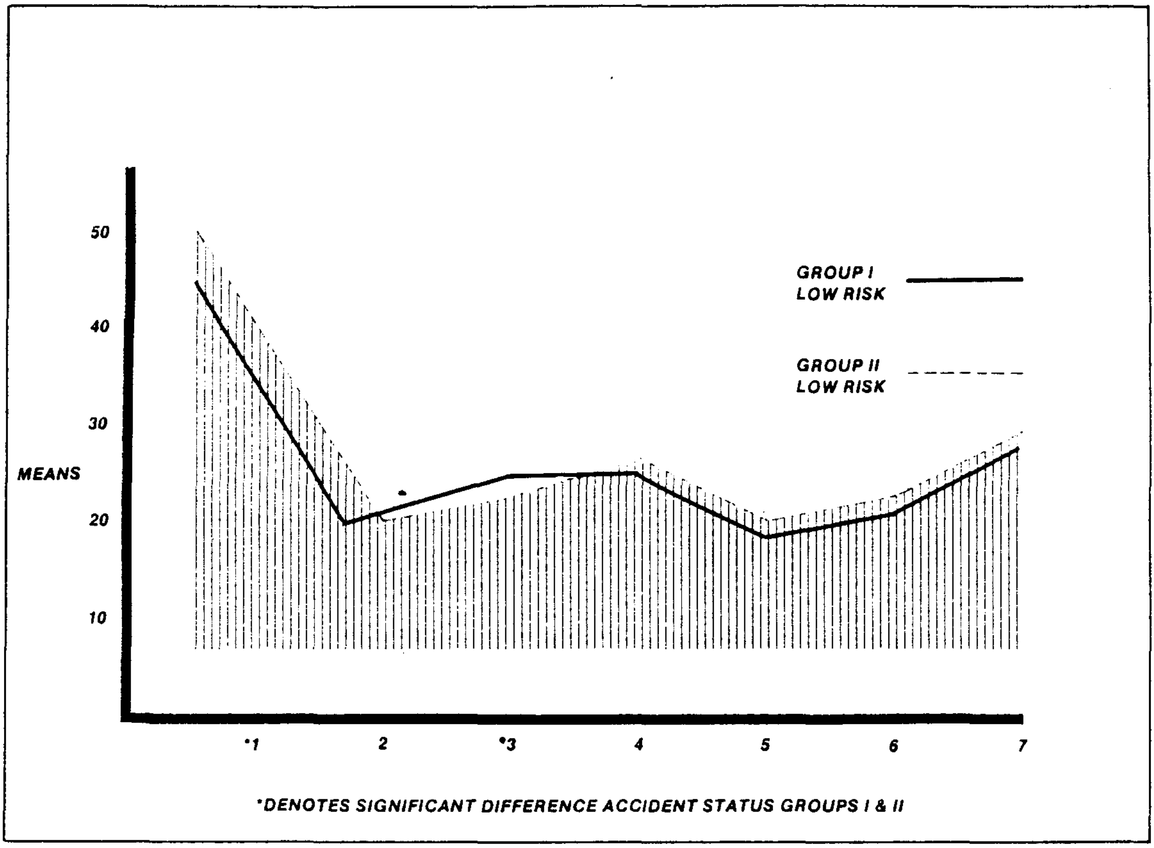
9. Low Risk Company, determined by incidence rates of 6 or less per 100 employees, e.g., (CONDITIONS) packaging, manufacturing, food processing, engineering and scientific instruments, hand tools & machines.

10. Temporary total disability is an injury which does not result in death or permanent disability, but which renders the injured person unable to perform regular duties or activities on one or more full calendar days after the day of the injury. (Used in this study).

11. Work injuries (including occupational illness) are those which arise out of and in the course of gainful employment regardless of where the accident occurs. Excluded are work injuries to private household workers and injuries occurring in connection with farm chores which are classified as home injuries.

12. Workers are all persons gainfully employed, including owners, managers, other paid employees, the self-employed, and unpaid family workers, but excluding private household workers.

APPENDIX IX


50
40
30
MEANS
20
10
GROUP I
LOW RISK
GROUP II
LOW RISK
•1
2
•3
4
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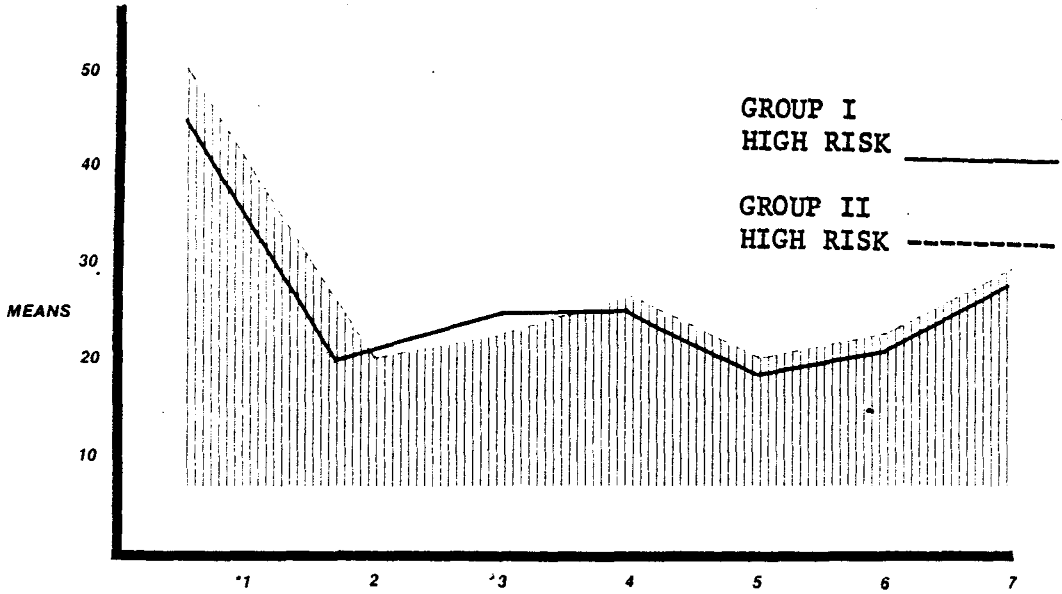
6
7
•DENOTES SIGNIFICANT DIFFERENCE ACCIDENT STATUS GROUPS I & II



*DENOTES SIGNIFICANT DIFFERENCE ACCIDENT STATUS GROUPS I & II

APPENDIX X

MULTIVARIATE ANALYSIS

HIGH RISK AND LOW RISK INDUSTRIES

CELL MEANS AND STANDARD DEVIATIONS

VARIABLE	CODE	x	SD
SCALE 1	NA		
PATHO	HIGH RISK	40.05	8.76
PATHO	LOW RISK	46.93	6.35
	A		
PATHO	HIGH RISK	42.29	8.43
PATHO	LOW RISK	49.00	6.21
SCALE 2	NA		
PATHO	HIGH RISK	16.99	4.66
PATHO	LOW RISK	17.23	4.09
	A		
PATHO	HIGH RISK	17.32	4.38
PATHO	LOW RISK	17.76	3.99
SCALE 3	NA		
PATHO	HIGH RISK	23.73	5.31
PATHO	LOW RISK	21.51	4.17
	A		
PATHO	HIGH RISK	22.60	5.04
PATHO	LOW RISK	9.14	6.20
SCALE 4	NA		
PATHO	HIGH RISK	21.21	4.27
PATHO	LOW RISK	22.18	3.22
	A		
PATHO	HIGH RISK	21.54	3.97
PATHO	LOW RISK	23.12	2.59

VARIABLE	CODE	x	SD
SCALE 5	NA		
PATHO	HIGH RISK	14.98	4.18
PATHO	LOW RISK	16.30	3.10
	A		
PATHO	HIGH RISK	15.31	4.69
PATHO	LOW RISK	17.30	3.08
SCALE 6	NA		
PATHO	HIGH RISK	18.07	3.68
PATHO	LOW RISK	18.30	2.87
	A		
PATHO	HIGH RISK	18.19	3.06
PATHO	LOW RISK	18.66	3.11
SCALE 7	NA		
PATHO	HIGH RISK	23.45	3.97
PATHO	LOW RISK	23.30	3.88
	A		
PATHO	HIGH RISK	23.60	3.81
PATHO	LOW RISK	24.57	2.78

N = 347

PATHO - COMPANY'S RISK RATING

APPROVAL SHEET

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The final copies have been examined by the director of the dissertation and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the dissertation is now given final approval by the Committee with reference to content and form.

The dissertation is therefore accepted in partial fulfillment of the requirements for the degree of Doctor of Education.

October 15, 1985
Date

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