A Cross-Cultural Examination: Effects of Reward Systems and Cultures on Low Severity Risk-Taking Behavior in Construction

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ABSTRACT

The overall research objective was to identify the effects of reward systems (rewards and a penalty) on risk-taking behavior and performance (quality and time) of construction workers from different cultures (American, Asian, and Latin American cultures). This research used the sociotechnical system as the underlying, guiding scientific framework. The research found that Americans and Latin Americans had higher risk-taking behavior than Asians ($p<0.01$). No difference in risk-taking behavior was found between Americans and Latin Americans ($p<0.05$). Although culture may influence individuals' risk-taking behavior, the results from this study showed that risk-taking behavior could be altered and suppressed by providing individuals with the proper safety training, education, and safety equipment. Customized safety training for people from different cultures would be useful because the culture elements that contribute to high risk-taking behavior could be addressed. The results also showed that the effects of reward systems on risk-taking behavior were not statistically significant ($p>0.1$). One possibility that no difference was found may be because the tasks used in this study did not contain enough possibility for participants to take more risk. The effects of reward systems on risk-taking behavior may have been reduced by the low possibility of risky behavior. It is suspected that if the tasks contained more opportunities for participants to take risk, differences in risk-taking behavior would have been significant.

The researcher concluded that risk perception is situation-specific and has an influence on the individual's risk-taking behavior on that particular situation but cannot be used to predict risk-taking behavior. Also, general locus of control and general self-efficacy cannot be used to predict risk-taking behaviors. These findings are consistent with many studies that explore locus of control (Iversen & Rundmo, 2002; Rolison &

Scherman 2002; Crisp & Barber, 1995), and many researchers that suggested self-efficacy is situation specific (Murdock et al., 2005; Martin et al., 1995; Perraud, 2000; Slanger & Rudestam, 1997). This study also found no relationship between risk-taking behavior and productivity, for both time and quality.

Dedication

For Mom and Dad

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Table of Contents

List of Figures

List of Tables

Chapter 1: Introduction

The construction industry is characterized by significant occupational safety and health risks. Governments have implemented the national occupational health and safety programs to help reduce the number of injuries and fatalities. Construction companies use various safety programs to implement safety culture at an organizational level, while researchers have provided numerous accident-prevention tools and knowledge. There has also been an initiative to share and exchange information at the international level by the establishment of the International Labour Organization (ILO). [a]ILO (2006) is the United Nations specialized agency that promotes social justice and international recognition of human and labor rights ([a]ILO, 2006). In the area of occupational safety and health, [b]ILO (2006) encourages and facilitates "the exchange of information on national policies, systems and programmes on occupational safety and health, including good practices and innovative approaches, and the identification of new and emerging hazards and risks in the workplace" (p.10). ILO has suggested that the injury rates for many industrialized countries are decreasing, while the rates are increasing in many developing countries ([c]ILO, 2006). However, when taking a closer look at the data available, it is difficult to compare the injury and fatality rates between countries ([d]ILO, 2006). This is because the data collection methods and the scales used to report these rates vary. For example, Panama uses insurance records method and reports the rates per 100,000 employees, while Japan uses the labor inspectorate records method and reports the rates per 1,000,000 hours worked. Sharing and exchanging information, and adopting new practices and approaches among countries is not easy. Practices and approaches that are effective in one country may not be effective in another because each country has its own culture, values, and practices. In an industry that is labor-intensive, such as the construction industry, taking into account the employees' culture is very important in analyzing many problems that could stem from cultural differences.

1.1 Problem Statement

Hourly wage is the type of base pay that is considered fair by both employers and employees. It ensures that construction companies have met the hourly wage requirements given by the law. Rewards and penalties are used in conjunction with the base pay to evoke desired behaviors and eliminate undesired behaviors. These rewards and penalties may induce construction workers to engage in higher risk-taking behavior to receive these rewards or to avoid penalties. Two studies have examined how pay incentives affect workers' behavior. First, a study conducted by Sawacha, Naoum, and Fong (1999) found a strong relationship between productivity bonus pay and safety performance. They concluded that bonus pay induces construction workers to increase their work pace and engage in unsafe behavior. Second, a study conducted by Guadalupe (2003) found that short term construction workers are more likely to be involved in an accident than permanent contract workers. Even though Guadalupe (2003) concluded that the companies' investment in human capital is the root cause, job reward systems should not be overlooked. As companies invest and pay short term construction workers less than permanent contract workers, it is possible that reward systems may have an impact on workers' risk-taking behavior, which leads to higher accident rates for the short term workers. Note that both studies were conducted domestically, Sawacha et al.(1999) in Spain and Guadalupe (2003) in the U.K.. With the movement to share and exchange information at an international level, a study that examines the effects of reward systems at the international level was needed to help reduce the numbers of injuries and fatalities worldwide.

1.2 Research Objectives

The overall research objective was to identify the effects of reward systems (rewards and penalties) on risk-taking behavior and performance (quality and time) of construction workers from different cultures (American, Asian, and Latin American cultures). The secondary objectives of this research were:

1. To identify the effects of reward systems on risk-taking behavior of construction workers who are from the same culture.

2. To identify the effects of reward systems on the risk-taking behavior of construction workers who are from different cultures.
3. To identify the relationship between construction workers' performance and their risk-taking behavior, when exposed to different reward systems.
4. To identify the effects of construction workers' risk perception and social cognitive dimensions (locus of control and self-efficacy) on their risk-taking behavior, when exposed to different reward systems.
5. To identify whether construction workers' general risk perception could be used to predict their construction risk perception.

1.3 Research Overview

This research used the sociotechnical system as the underlying, guiding scientific framework. The sociotechnical system is the work system comprised of (1) a personnel subsystem, (2) a technological subsystem, (3) an organizational design, and (4) an external environment (Hendrick & Kleiner 2001). The effects of an external environmental component (culture), an organizational design component (reward systems), and the technological subsystem (task) on the personnel subsystem components, including risk-taking behavior and performance, are the focal points of this research. Figure 1.1 portrays the overall picture of this research. This figure is based on the work of Hendrick's sociotechnical system (as cited in Kleiner, 1998).

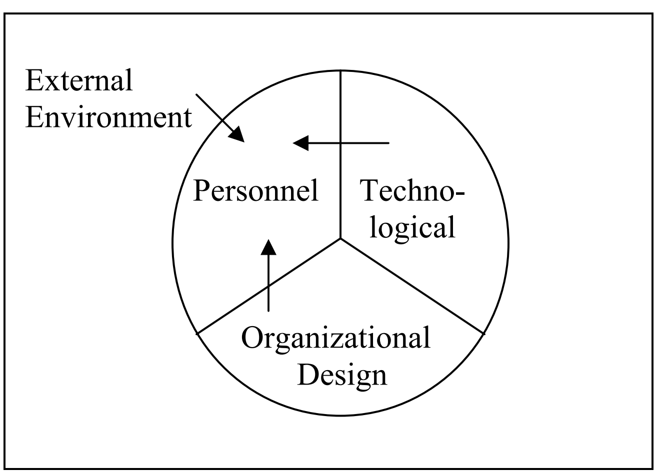


Figure 1.1: The interactions of sociotechnical system components are under investigation (the sociotechnical model was modified from Hendrick as cited in Kleiner, 1998).

1.4 Conceptual model

A conceptual model for this research is presented in Figure 1.2. When participants from different cultures were exposed to different reward systems, they were expected to react differently based on their risk perception, locus of control, and self-efficacy. Their reactions were expected to be shown in the performance of the task, and their risk-taking behavior. The performance on the tasks was measured by the quality and time an individual took to complete the task. Risk-taking behavior was measured by using an observation sheet and a risk-taking behavior questionnaire developed for this research.

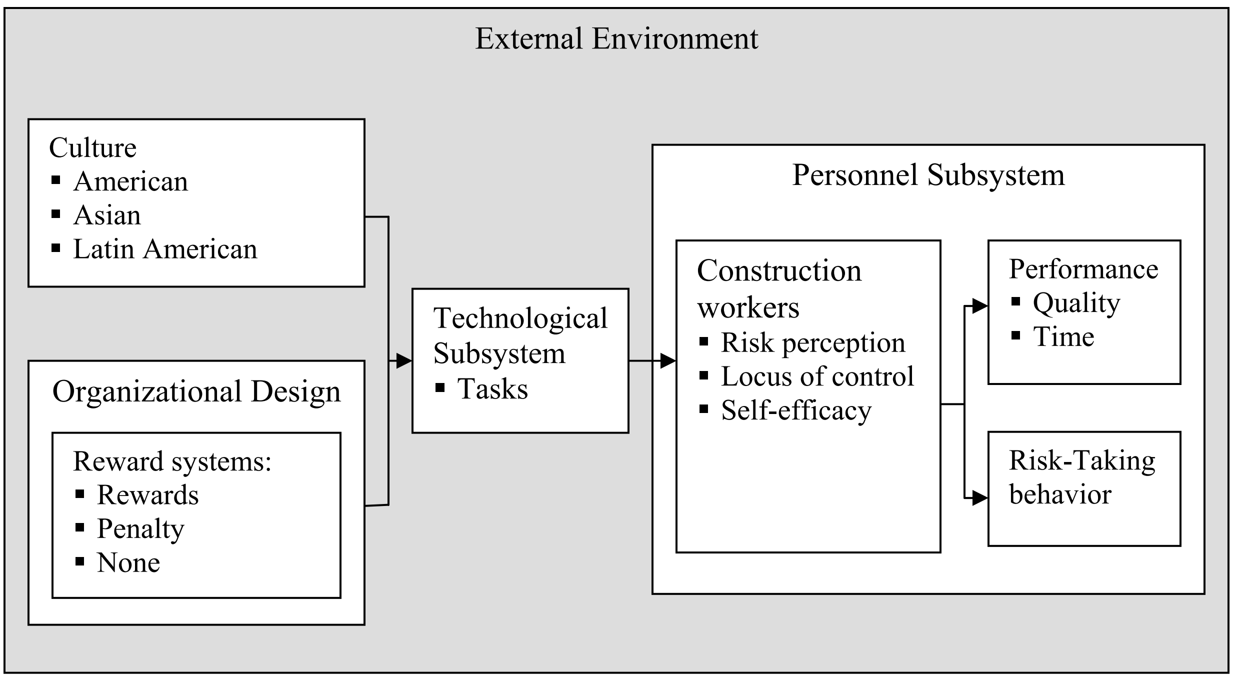


Figure 1.2: Conceptual model.

1.5 Operational Research Model

This study had three independent variables and two dependent variables. The three independent variables were the cultures (American, Asian, and Latin American), the reward systems (rewards, penalty, and none), and traits (risk perception, locus of control, and self-efficacy). The two dependent variables were risk-taking behavior and performance. The operational research model in Figure 1.3 shows the proposed relationships among the independent and dependent variables, as well as the related research hypotheses.

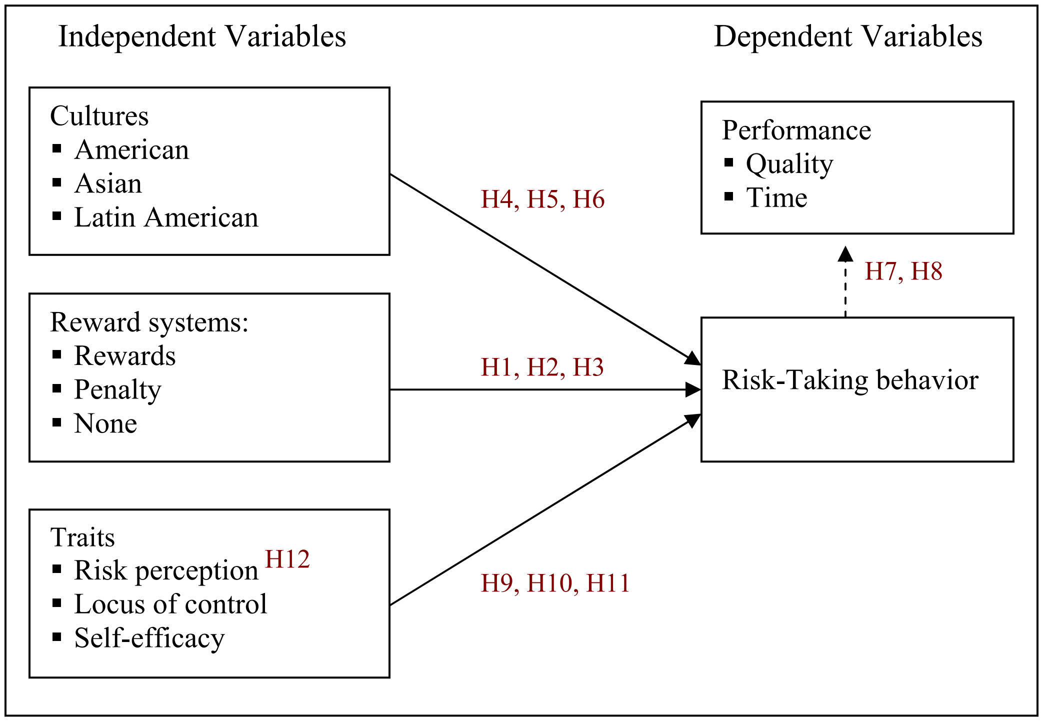


Figure 1.3: Operational research model.

1.6 Research Hypotheses

Based on a review of the literature and the research objectives, the hypotheses for this study are presented below:

Hypothesis 1: When exposed to rewards, construction workers' risk-taking behavior will be higher than when there is none.

As mentioned earlier, Sawacha et al. (1999) found that bonus pay based on productivity increases the risk-taking behavior of construction workers. Therefore, the researcher for the current study hypothesized that when rewards are present the construction workers would try to reach the companies desired productivity level. Thus, the workers can receive the rewards, even though this means that they might have to engage in unsafe activities by increasing their work pace.

Hypothesis 2: When exposed to a penalty, construction workers' risk-taking behavior will be higher than when there is none.

The rationale for this hypothesis is similar to the rationale that supports hypothesis 1. The researcher suspected that the penalty, due to a lack of productivity, would create an effect similar to that of the reward. With the fear of losing earnings, construction workers would take higher risks in order to achieve the employers desired productivity level.

Hypothesis 3: When exposed to a penalty, construction workers' risk-taking behavior will be higher than when rewards are offered.

This hypothesis suggests that a penalty has a greater effect on construction workers than rewards. This is because, without rewards, construction workers are still able to receive their expected earnings, while with a penalty, their earnings could be jeopardized.

Hypothesis 4: When exposed to rewards, the extent of risk-taking behaviors of construction workers who are from different cultures will be different.

> **Hypothesis 4A:** When exposed to rewards, the risk-taking behavior of construction workers from Asia will be higher than the risk-taking behavior of construction workers from the U.S.
>
> **Hypothesis 4B:** When exposed to rewards, the risk-taking behavior of construction workers from Latin America will be higher than the risk-taking behavior of construction workers from the U.S.
>
> **Hypothesis 4C:** When exposed to rewards, the risk-taking behavior of construction workers from Latin America will be higher than the risk-taking behavior of construction workers from Asia.

Hypothesis 5: When exposed to a penalty, the extent of risk-taking behaviors of construction workers from different cultures will be different.

Hypothesis 5A: When exposed to a penalty, the risk-taking behavior of construction workers from Asia will be higher than the risk-taking behavior of construction workers from the U.S.

Hypothesis 5B: When exposed to a penalty, the risk-taking behavior of construction workers from Latin America will be higher than the risk-taking behavior of construction workers from the U.S.

Hypothesis 5C: When exposed to a penalty, the risk-taking behavior of construction workers from Latin America will be higher than the risk-taking behavior of construction workers from Asia.

Hypothesis 6: When there is no reward or penalty, the extent of risk-taking behaviors of construction workers from different cultures will be different.

Hypothesis 6A: When there is no reward or penalty, the risk-taking behavior of construction workers from Asia will be higher than the risk-taking behavior of construction workers from the U.S.

Hypothesis 6B: When there is no reward or penalty, the risk-taking behavior of construction workers from Latin America will be higher than the risk-taking behavior of construction workers from the U.S.

Hypothesis 6C: When there is no reward or penalty, the risk-taking behavior of construction workers from Latin America will be higher than the risk-taking behavior of construction workers from Asia.

There have been no studies comparing the occupational risk-taking behavior of people from various regions of the world. Most of the available literature in risk-taking behavior is focused either domestically or on other types of risk-taking behavior such as driving, sexual, and adolescent risk-taking behavior (Iversen & Rundmo, 2002; Rolison & Scherman, 2002). However, there are studies that have examined risk perception and injuries among different ethnicities in the U.S. (Vredenburg & Cohen, 1995: Richardson, Loomis, Bena, & Bailer, 2004; Strong & Zimmerman, 2005). The U.S. Bureau of Labor

Statistics (Richardson, 2005) reported that the fatality rate of foreign-born Latin American workers in the U.S. in 2004 was 5.9 per 100,000 workers, which was much higher than the rate of 4.1 for all U.S. workers. Limited statistics retrieved from [d]ILO (2006), shown in Appendix A, indicate that the fatality rates in Hong Kong, Singapore, South Korea, Taiwan, Argentina, Brazil, Bolivia, Columbia, Costa Rica, Honduras, Nicaragua, and Panama are mostly higher than in the U.S. Based on these studies, it was suspected that Americans have the lowest risk-taking behavior, followed by Asians, and Latin Americans respectively.

Hypothesis 7: The quality of a task decreases when the risk-taking behavior increases.

It was suspected that when a reward system was offered, whether it be a reward or a penalty, construction workers' risk-taking behavior would increase. Their work pace would increase in order to meet the productivity desired by the employer. This would lead to a decrease in quality because the construction workers would not give the task the attention they would if they were not rushed.

Hypothesis 8: The time required to finish a task decreases when the risk-taking behavior increases.

It was suspected that when a reward system was offered, whether it be a reward or a penalty, construction workers' risk-taking behavior would increase. Hence, their work pace would increase in order to meet the productivity desired by the employer. Therefore, they are more likely to finish the task sooner than they would if they were to work at a slower pace.

Hypothesis 9: Construction workers with a lower construction risk perception have a higher risk-taking behavior than construction workers with a higher construction risk perception, when exposed to different reward systems.

There was no conclusion available in the literature as to whether risk perception can be used to predict risk-taking behavior. Rundmo (2003) found in his study in the offshore oil industry that risk perception could not be used to predict risk behavior. However, the risk compensation theory proposed that an individual's risk-taking behavior is influenced by risk perception and the propensity to take risks (Adam, 1995). Individuals with a low risk perception are unaware of the possible consequences, so they would be more willing to take the risk. Therefore, the researcher suspected that an individual's risk perception would influence their risk-taking behavior.

Hypothesis 10: Construction workers with an external locus of control have higher risk-taking behavior than construction workers with an internal locus of control, when exposed to different reward systems.

Researchers reported that individuals with an internal locus of control tend to take fewer risks than individuals with an external locus of control. Montag and Comrey (1987) reported that individuals with an external locus of control are involved in more accidents. Martin (2002) concluded from her study that individuals with a higher internal locus of control are more likely to look for and comply with hazard warnings. Salminen and Klen (1994) found that construction and forestry workers with an internal locus of control tend to take fewer risks in their jobs. Wuebker (1986) found that employees with an internal locus of control are likely to have fewer accidents and injuries at work than the external counterparts.

Hypothesis 11: Construction workers with high self-efficacy have lower risk-taking behavior than construction workers with low self-efficacy, when exposed to different reward systems.

People with high self-efficacy view difficult tasks as challenging instead of threatening (Bandura, 1994). They approach difficult situations with assurance. They feel accomplished and satisfied with themselves. If failure occurs, they believe that it is due to insufficient knowledge and skills. Failure on a task does not harm their self-confidence. On the other hand, people with low self-efficacy lack self-confidence, aspiration, and commitment to goals (Bandura, 1994). They view difficult tasks as threats and approach them with a pessimistic attitude. It does not take much of a failure to reinforce doubts about their capabilities. Bandura (1994) also suggested that people with stronger self-efficacy are healthier and less likely to engage in health impairing habits. Self-efficacy has been noted to influence how people perceive warnings. It was suspected that people with low self-efficacy are less likely to comply with warnings (Dejoy, 1999).

Hypothesis 12: Construction workers' general risk perception differs from their construction risk perception.

Many studies have examined risk perception in general (Leonard et al., 1989; Leonard et al., 1990; Leonard & Hill, 1989; Vredenburgh & Cohen, 1995) while others focused on specific types of risk (Ulleberg and Rundmo, 2003; Weber, Blais, & Betz, 2002). There was no evidence whether general risk perception may represent the overall risk perception of an individual such as health, sexual, driving, and alcohol consumption risk perceptions. Therefore, this study investigated whether the individuals' construction risk perception could be predicted by their general risk perception.

1.7 Definition of Terms

Acculturation: "Acculturation comprehends those phenomena which result when groups of individuals having different cultures come into continuous first-hand contact, with subsequent changes in the original cultural patterns of either or both groups" (Redfield, Linton, & Herskovits, 1936, p.149).

Americans: Individuals who identify themselves as a U.S. citizen.

Asians: Individuals who identify themselves as a citizen of Brunei, Burma, Cambodia, China, Hong Kong, Indonesia, Japan, Laos, Malaysia, Philippines, Singapore, South Korea, Taiwan, Thailand, or Vietnam.

Construction workers: Workers in the construction industry whose daily tasks are of the hands-on type. These include but are not limited to masons, roofers, carpenters, and daily laborers.

Culture: "the collective programming mind that distinguishes the members of one group or category of people from another" (Hofstede, 2001, p.9)

Latin Americans: Individuals who identify themselves as a citizen of Argentina, Belize, Bolivia, Brazil, Chile, Columbia, Costa Rica, Dominican Republic, Ecuador, El Salvador, French Guiana, Guatemala, Guyana, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay, or Venezuela.

Locus of control: Rotter (1966, p. 1) described locus of control as follows:

> When a reinforcement is perceived by the subject as following some action of his own but not being entirely contingent upon his action, then, in our culture, it is typically perceived as the result of luck, chance, fate, as under the control of powerful others, or as unpredictable because of the great complexity of the forces surrounding him. When the event is interpreted in this way by an individual, we have labeled this a belief in external control. If the person perceives that the event is contingent upon his own behavior or his own relatively permanent characteristics, we have termed this a belief in internal control.

Risk perception: "People's beliefs, attitudes, judgments, and feelings about hazards, dangers, and risk taking, within the wider context of social and cultural values." (Mearns & Flin, 1995, p. 299-300).

Risk-taking behavior: "Any consciously or non-consciously controlled behavior with a perceived uncertainty about its outcome, and/or about its possible benefits or cost for the physical, economic or psycho-social well-being of oneself or others" (Trimpop, 1994, p.9).

Self-efficacy: The individuals' beliefs about their capabilities to carry out actions that result in specific performance (Bandura, 1994; Pajares, 2002).

Chapter 2: Review of the Literature

In this chapter, relevant literature for this research is presented.

2.1 Macroergonomics

Macroergonomics, the technical domain serving as the context of this work, is "a top-down sociotechnical systems approach to the design of work systems and the carry-through of the overall work system design characteristics to the micro-ergonomic design of human-job, human-machine, and human-software interfaces to ensure that the entire work system is fully harmonized" (Hendrick & Kleiner, 2001, p. 121). Macroergonomics is a subdiscipline of human factors or ergonomics that focuses on a human-centered approach to the overall design of a work system (Hendrick & Kleiner, 2001; [a]Hendrick, 2002). Ergonomics, or human factors, is "the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human and societal well-being and overall system performance" (The International Ergonomics Association, 2005).

Macroergonomics is not new. It was introduced to the ergonomics discipline in the 1940s. However, during the three decades following its introduction, the focus was on micro-ergonomics, which is the interface of a single worker and the immediate work environment (Hedrick, 2002). Macroergonomics presents a paradigm shift in the work system design that integrates the social and technical structures of the system together. Hedrick (2002) identified that the traditional work system design fails because of three major pitfalls, which are (1) technology-centered design, (2) a leftover approach to function and task allocation, and (3) a failure to consider the system's sociotechnical characteristics.

The first pitfall, technology-centered design, occurs when the focus of the design is on the technology or the machine instead of the humans who will use or operate the workstations. In the second pitfall, a leftover approach to function and task allocation, humans are assigned to the tasks which are leftover from the machines. The system designers do not consider whether the tasks are appropriate or suitable for the operators. The third pitfall occurs when the system designers fail to consider the system's sociotechnical characteristics in the design. The four major sociotechnical components are (1) the technological subsystem, (2) the personal subsystem, (3) the external environment, and (4) organizational design ([a] Hendrick, 2002).

From Hendrick's ([a] 2002) extensive experience in work system design, he suggested three criteria to select an effective design approach (1) joint design, (2) a humanized task approach, and (3) integration of the organization's sociotechnical characteristics into the design. The macroergonomics approach has all three of these characteristics.

Macroergonomics has been widely used and has demonstrated to be successful in many types of organizations, including business, government, and academia (Kleiner, 1996). At TRW, a manufacturer for aircraft components, macroergonomics has helped improve the manufacturing process by reducing travel time, enhancing product quality, and improving productivity. At the Office of Environment Management, which is part of the U.S. Department of Energy, macroergonomics has helped speed up the implementation of safety culture. At the University of New York-Buffalo, macroergonomics has helped to increase funding opportunities and students' accessibility to faculty (Kleiner, 1996).

2.2 Sociotechnical System

Sociotechnical system theorists view an organization as an open system and have used it as a framework to analyze and improve organizations (Pasmore & Sherwood, 1978). A sociotechnical system is a work system comprised of (1) a personnel subsystem, (2) a technical subsystem, (3) an organizational design, and (4) an external environment (Hendrick & Kleiner, 2001).

2.2.1 Personnel Subsystem

The personnel subsystem consists of people within the organization. There are three major characteristics of the personnel subsystem that should be taken into consideration when researchers approach work systems. These characteristics are (1) the degree of professionalism, (2) demographic characteristics, and (3) psychological factors (Hendrick & Kleiner, 2001; [b]Hendrick, 2002). The degree of professionalism indicates the skill and professional knowledge needed by the workforce. Demographic characteristics refer to many characteristics upheld by the organization's workforce. These include, but are not limited to, values, cultures, and increased numbers of women in the workplace. These characteristics define differences between one organization and another. Psychological factors refer to humans' cognitive complexity. Cognitive complexity has two major dimensions: differentiation and integration ([b]Hendrick, 2002). Differentiation refers to the number of conceptual categories and subcategories that a person has developed. Integration refers to the number and combination of rules a person has acquired.

2.2.2 Technological Subsystem

The technological subsystem consists of machines, tools, software, and other technological components (Hendrick & Kleiner, 2001). The technological subsystem can be analyzed by various types of systems defined by the experts. These include, but are not limited to, (1) production technology, (2) knowledge-based technology, (3) technological uncertainty, and (4) workflow integration ([b]Hendrick, 2002). Production technology categorizes a technological system by the mode of production, including unit, mass, and process production, which is mostly applied to manufacturing firms. Knowledge-based technology categorizes technological systems by the action performed on an object. It categorizes the system into four types, which are routine, non-routine, engineering, and craft. Technological uncertainty classifies a technological system according to the organization's strategy to reduce uncertainty. There are three types of technological uncertainty, namely long-linked (*i.e.* an assembly line), mediating (*i.e.* a post office and a bank), and intensive (*i.e. a* hospital). Workflow integration refers to "the degrees of automation, workflow rigidity, and quantitative specificity of evaluation of work activities" ([b]Hendrick, 2002, p. 46).

2.2.3 Organizational Design

Organizational design is the organization structure and its functions. There are four major types of organizational design, which are (1) classical machine bureaucracy, (2) professional bureaucracy, (3) matrix organization, and (4) free-form design. Classical machine bureaucracy operates by rules and authorities assigned to employees. Some characteristics of this design include well-defined routine tasks, a highly hierarchical structure, extensive rules and regulations, and centralized decision-making (Hendrick & Kleiner, 2001; [b]Hendrick, 2002). Professional bureaucracy design relies on a high degree of professionalism. Its characteristics include broadly defined tasks, fewer levels of hierarchy, decentralized decision-making, and less routine tasks. The unique characteristic of the matrix organization design is the combination of the departmentalized structure and the project or product line operation (Hendrick & Kleiner, 2001; [b]Hendrick, 2002). Employees can work on various projects while also belonging to functional departments. For the organizations that use free-form design, they change the organizations' structures to suit the situation or condition that they face. Employees are ready to adapt to changes and have high personal flexibility.

2.2.4 External Environment

The external environment consists of the environment surrounding the work system that could influence how the work system functions. This includes socioeconomic, educational, political, cultural, and legal aspects surrounding the organization (Hendrick & Kleiner, 2001; [b]Hendrick, 2002). The socioeconomic aspect refers to "the degree of stability of the socioeconomic environment, nature of the competition, and availability of materials and qualified workers" (Hendrick & Kleiner, 2001, p.55). The educational aspect refers to the availability of educational and training programs around the area. The political aspect refers to the degree of political stability and the attitudes of the government towards the business. The cultural aspect includes all the cultural dimensions of a society, such as values, norms, social aspects, and a union or non-union workforce. The legal aspect concerns all the rules and regulations at both the national and local levels.

2.3 Theories of Motivation

Motivation theories are reviewed in this section to help understand the reasons behind the behaviors of construction workers when rewards or penalties are in place. Researchers have proposed several motivation theories, some of them similar, and some unique. The relevant theories are as follows.

2.3.1 Maslow's Hierarchy of Needs

Abraham Maslow developed a hierarchy of needs. He suggested that humans' needs are hierarchical in nature (Maslow, 1954). This means that low level needs have to be satisfied before a person will pursue higher level needs. Maslow's hierarchy comprises five categories of needs. These needs, ranging from a low to a high level are (1) physiological, (2) safety, (3) social (belonging and love), (4) esteem, and (5) self-actualization (Maslow, 1954; Maslow, Stephens, & Heil, 1998). Short descriptions of these needs are as follows:

(1) Physiological needs: These needs occur from the desire of humans to stay alive. These include, but are not limited to, the needs for food, air, and water to keep one functioning.

(2) Safety needs: As physiological needs are met, needs to be safe from physical and psychological harm arise. These needs include security, stability, and freedom from fears, anxiety, and chaos.

(3) Social needs: After physiological and safety needs are satisfied, people search for love, friends, a sense of belonging, and affection. They want to be part of a group or a family and they want to socialize with others.

(4) Esteem needs: After the first three needs are satisfied, people want to feel valued, important, or significant. They want to receive respect from others. These needs are classified into two categories. The first category is the need for achievement and accomplishment. The second category is the need for recognition by others, such as reputation, attention, and appreciation.

(5) Self-Actualization needs: After esteem needs are satisfied, people strive to excel at what they do in order to reach their fullest potentials. This is the need for self-fulfillment, such as the needs for truth, wisdom, and meaning.

2.3.2 Goal-Setting Theory

The goal-setting theory claims that people work harder when goals are in place (Locke & Latham, 1984). Goals help direct attention and action, mobilize energy and effort, increase persistence, and motivate the development of task strategies (Locke & Latham, 1984). Good goals need to be measurable, specific, challenging, realistic, and time-oriented (Lock & Latham, 1984).

2.3.3 Expectancy Theory

Victor Vroom is one of the pioneers of expectancy theory. He believes that the motivation of an individual to perform a task depends on the attractiveness of the rewards and the perception of the individual's capability. His model of motivation is as follows (Vroom, 1984):

$$\text{Force} = \text{Valence} * \text{Expectancy}$$

Force refers to the individual's motivation to perform a task. Valence refers to the value perceived by the individual of the outcome of the task. Expectancy refers to the perceived capability of the individual to accomplish the task.

2.3.4 Skinner's Reinforcement Theory

B.F. Skinner (1969) conducted laboratory experiments using rodents and a piece of equipment that he called the Skinner Box. Each Skinner Box contains a food dispenser, which dispenses food when the bar is pressed, and an electric wired floor. The reinforcement theory is based on the principle of consequences. It claims that people will carry out activities that lead to desirable outcomes, while avoiding activities that lead to undesirable outcomes. The aspects of consequences proposed by Skinner are as follows:

- Positive reinforcement increases desired behavior by giving rewards when the behavior is present.
- Negative reinforcement increases desired behavior by taking away penalties when behavior is present
- Punishment decreases undesired behavior by taking away rewards or giving penalties when the behavior is present.

2.4 Risk

There is no commonly accepted definition of risk among researchers because the form and the level of the risks vary (Yates & Stone, 1992; Joffe, 2003). Yates and Stone (1992) suggested there are three components that make up risk: (1) potential, (2) significance, and (3) uncertainty of loss. Researchers have extensively investigated risks in various areas, such as driving, smoking, consumer products, environmental hazards, health, and business. They have also examined individuals' risk perception and risk-taking behavior when exposed to various risk situations. The theory of risk compensation explains human behavior when faced with risk (Adams, 1995). The model of this theory is a conceptual model, not an operational one. Figure 2.1 presents the graphics of the model.

In the risk compensation theory, an individual's risk-taking behavior is influenced by the individual's risk perception and propensity to take risks. An individual's propensity to take risks is influenced by the rewards of such a risky action. An individual's risk perception is influenced by the accidents or experiences of such risk by himself/herself or others.

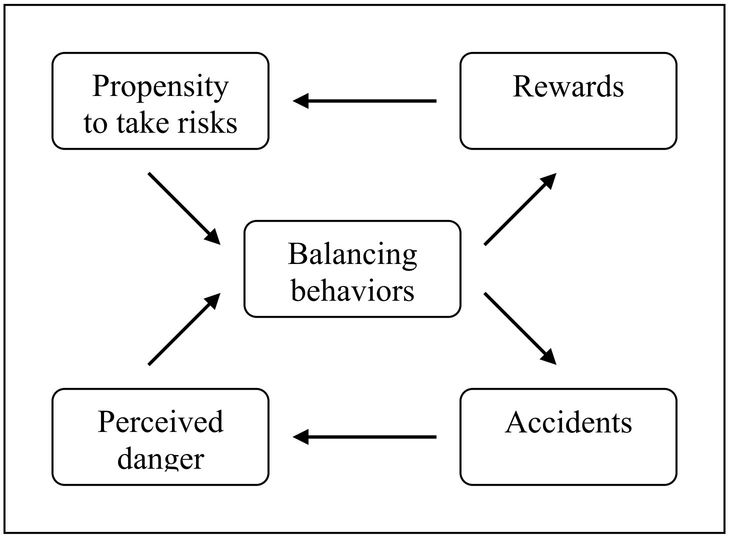


Figure 2.1: The model of risk compensation theory (modified from Adams, 1995).

From the model, the individuals' risk perception, risk-taking behavior, and perceived rewards influence the likelihood that an accident may occur. Some researchers have directly and indirectly supported the idea. Brown (2005) studied the driving behavior of people and concluded that an increase in risk-taking behavior leads to lower risk perception. But it cannot yet be concluded whether or not higher risk perception leads to lower risk-taking behavior. Turner, McClure, and Pirozzo (2004) reviewed seven studies and concluded that risk-taking behavior increases the chances of injury except in the case of highly skilled people involved in risk-taking behavior sports. Note that four of the studies were on car crashes, one study was on spinal cord injury, and two studies were on skiing.

2.4.1 Risk Perception

Risk perception is the degree to which an individual *feels* threatened by risk. Risk perception research is "the study of people's beliefs, attitudes, judgments and feelings about hazards, danger, and risk-taking, within the wider context of social and cultural values" (Mearns & Flin, 1995, p. 299-300). Risk perception research started with the nuclear risk debate in the 1960s (Sjoberg, 2000). Since then, risk perception has been explored and published from various perspectives, including social, cultural, and psychological paradigms (Kasperson, 1992; Rayner, 1992; Slovic, 1992). Cognitive psychology and the study of humans' decision-making behavior enhances our understanding of risk perception (Mearns & Flin, 1995). Cognitive psychology is the study of the memory, perception, problem solving, thought, and reasoning of humans (Mearns & Flin, 1995; Elsevier, 2005). Researchers have used many approaches to explain risk perceptions. Among many approaches are the psychometric model, risk target, and cultural theory of risk perception (Sjoberg, 2000).

(1)The Psychometric Model: The psychometric model was initiated by the work of Fischhoff, Slovic, Lichtenstein, Read, and Combs (1978). The researchers asked people to rate hazards based on a set of risk attributes. Two factors used to describe risk perception were the unknown and dread (Slovic, Fischhoff, & Lichtenstein, 1985). The unknown factor involves the understanding and the effect time of the risk. The dread factor concerns the degree of the effect and controllability of the risk. Researchers found that people evaluate hazards based on objective and subjective risk assessment (Trumbo, 1995).

(2) Risk Target: The risk target is another issue that researchers need to be cautious of when conducting a study. It should be noted that people rate risks differently, depending on whom the risk is rated against. For example, it has been found that people often perceive that the level of risk they are exposed to is less than that of the general public (Sjoberg, 2000). However, when no instructions are given as to whether to rate the risk against themselves or others, the respondents usually rate the risk at the same level as they would rate that of the general public (Sjoberg, 2000).

(3) The Cultural Theory of Risk Perception: This theory was initiated by the work of Douglas and Wildavsky in 1982 (As cited in Sjoberg, 2000). The theory examines the relationship between culture and risk perception. This theory suggests that people perceive and react to risk differently, due to cultural biases. "Worldviews" is sometimes used to refer to cultural biases by many authors

(Bouyer, Bagdassarian, Chaabanne, & Mullet, 2001). These cultural biases or worldviews refer to "shared beliefs and values, and contemporary worldviews representing a person's way of responding to controversies over technology and society" (Dake, 1991, p.61). Worldviews are categorized into four groups: egalitarian, hierarchical, individualistic, and fatalistic. Dake (1991) examined three out of four worldviews. He concluded that there is a connection between individual worldviews and risk perceptions at the societal level. Details of each worldview are described below (Thompson, Ellis, & Wildavsky, 1990; Adams, 1995):

- *Egalitarian:* Egalitarians do not trust authorities or people from outside of the group. They trust only people within their group. They do not trust any systems that could enclose hidden and irreversible threats such as global warming and nuclear power. Examples of this group are members of religious and environmental groups.
- *Hierarchical:* A hierarchical society is bounded and guided by authority and position. Hierarchies expect and trust the experts or authorities to set the level of acceptable risk. Examples of people in this group are soldiers and members of Hindu society.
- *Individualistic:* Individualists like to be in control and do not like to be controlled by others. They are the people who see risk as opportunity. They believe that without risk, reward does not exist. Entrepreneurs are examples of this group's members.
- *Fatalistic:* Fatalists do not make choices or thoroughly plan how they spend their lives. They do not worry about risk and believe that nothing could have been done. They live with the attitude that "what you don't know can't harm you" (Thompson et al., 1990, p.63). The fatalists are the outcasts and do not belong to any group.

Besides using the three approaches mentioned above, many researchers have conducted their studies by having participants rate the level of risk they perceived in different scenarios. Leonard and Hill (1989) examined whether individuals' experiences with hazards are associated with their risk perceptions. The study contained two parts. In the first part, participants were asked to provide the percentage of time they used seatbelts under various conditions. The results showed that traveling distance and the individuals' fear affects the frequency of seatbelt usage by the participants. The second part was conducted to investigate further whether an individuals experience with hazards might decrease fear and affect risk perception. Participants were asked to rate their risk perception in 16 situations, as shown in Table 2.1 (Leonard & Hill, 1989). The results showed that fear may increase risk perception, while experience with the hazards may reduce fear and risk perception.

Another study conducted by Leonard, Hill, and Karnes (1989) investigated the words used for risk warnings. The researchers asked participants to rate the level of risk in various scenarios. Then, the researchers asked another set of participants to select a word that matched the level of risk they perceived with each scenario. The scenarios used by these researchers are presented in Table 2.1 (Leonard et al., 1989).

Another study conducted by Leonard, Hill, and Otani (1990) investigated factors that contribute to risk perception. They asked participants to rate their risk perception in various scenarios on themselves, on the average male and female aged 15 to 25, and on average male and female aged 35-55. The hazard description used in this study is shown in Table 2.1 (Leonard et al., 1990). The result showed that young males perceive themselves as exposed to risks at a lower level than other groups of participants. .

Hazard Description	**Leonard & Hill (1989)**	**Leonard, Hill, & Karnes (1989)**	**Leonard, Hill, & Otani (1990)**
Going sky-diving	X		X
Watching a welder work without wearing welders glasses	X		
Working as an X-Ray technician	X		
Working as a pest exterminator	X		
Going SCUBA diving	X		
Helping to remove asbestos from buildings	X		
Having sex with a partner that you have known for a very brief time	X	X	X
Exceeding the speed limit by 30 miles or more	X	X	X
Driving the wrong way on a one-way street	X	X	X
Not wearing a seatbelt while you are driving a distance of over 30 miles	X		
Passing when the solid yellow line is in your lane	X	X	X
Living in a house that has potential for high levels of radon	X	X	X
Living near a source of radioactive pollution	X		X
Changing the tire on a car without blocking a wheel	X	X	X
Pulling an electric plug out of the socket by the cord	X	X	X
Being a passenger in a small private plane	X	X	X
Swimming in a lake that may be contaminated			X
Using an electric power saw/tool without wearing protective goggles		X	X
Being in the outdoors, away from shelter during an electrical storm		X	X
While walking in the woods, drinking from a stream whose source is unknown			X
Eating foods known to produce cholesterol in the body		X	X
Lifting a weight of 30 pounds or more from the floor			X
Exceeding the speed limit by 10 miles per hour		X	X
Jump starting a car without wearing protective goggles		X	X
Climbing up large steep rocks on a mountainside			X
Not wearing your seatbelt while you are driving a distance of over 20 miles		X	
Not wearing your seatbelt while you are driving a distance of less than 3 miles		X	
Failure to follow instructions for refrigerating or preserving food after opening package		X	
Not wearing your seatbelt while you are a passenger riding a distance of over 20 miles		X	X
Not wearing your seatbelt while you are a passenger riding a distance of less than 3 miles		X	
Having an appendectomy		X	
Talking on the phone during a thunderstorm		X	
Flying in a commercial airplane		X	

Table 2.1: Hazard descriptions used in three studies

(adapted from Leonard et al., 1989; ; Leonard & Hill, 1989; Leonard et al., 1990).

Many studies have examined risk perception in general (Leonard et al., 1989; Leonard et al., 1990; Leonard & Hill, 1989; Vredenburgh & Cohen, 1995) while others have focused on specific types of risk (Ulleberg and Rundmo, 2003; Weber, Blais, & Betz, 2002). There was no evidence as to whether or not general risk perception could represent the overall risk perception of the individuals such as health, sexual, driving, and alcohol consumption risk perceptions. Also, there was no well-known and accepted construction risk perception questionnaire that could be adapted for use in this study. Therefore this study investigated whether the individuals' construction risk perception could be predicted by their general risk perception. The risk perception questionnaire used in this study was composed of both general and construction risk perception. The general risk perception questionnaire was comprised of 18 questions selected from the work of Leonard and his co-authors (as shown in Table 2.1). These questions were selected based on the items that appears on at least 2 of the papers, and 2 items were included because they are work-related questions. Four questions were added from the work of Vrendenburgh and Cohen (1995), which made up 22 total questions for the general risk perception questionnaires. Vrendenburgh and Cohen's study is presented in the culture section (section 2.5). The construction risk perception questions were generated from interviews with the experts in construction and training documents from the Electronic Library of Construction Occupational Safety and Health (n.d.).

2.4.2 Risk-Taking Behavior

One individuals risk perception is different from those of another individual resulting in different actions taken by each individual. Even individuals with the same level of risk perception might have different levels of risk-taking behavior. Risk-taking behavior is "any consciously or non-consciously controlled behavior with a perceived uncertainty about its outcome, and/or about its possible benefits or cost for the physical, economic or psycho-social well-being of oneself or others" (Trimpop, 1994, p.9). Risk-taking behavior includes socially unacceptable behaviors where precautions are neglected that may put an individual or others in a harmful situation (Turner et al., 2004). Some examples of these behaviors are speeding, smoking, and drinking and driving. Socially acceptable behaviors where danger is recognized are also considered risk-taking behaviors (Turner, McClure, & Pirozzo, 2004). These behaviors include avalanche skiing, snowboarding, sky diving, and scuba diving. Researchers have also suggested that people take risks because they perceive the risk as an opportunity to lose something (Highhouse & Yuce, 1996). For example, people who choose to sky dive may perceive the activity as the opportunity to enjoy a thrilling experience. Teenagers may feel the threat of being unable to fit in with certain groups if they do not participate in activities such as using drugs and alcohol.

Data for risk-taking behavior and injury studies is usually drawn from surveys or self-reports (Turner et al., 2004). Over the years, researchers have developed various scales to help measure various aspects of risk-taking behavior such as Zuckerman's Sensation Seeking Scale (SSS). Zuckerman (1979) defined sensation seeking as "a trait defined by the need for varied, novel, and complex sensations and experiences and the willingness to take physical and social risks for the sake of such experience" (p. 10). SSS is used for measuring individuals' sensation seeking in the areas of (1) thrill and adventure seeking, (2) experience seeking, (3) disinhibition, and (4) boredom susceptibility (Zuckerman, 1979). Many researchers have also used risky driving behaviors and traffic offense behaviors (such as speeding, invalid driver's license, and alcohol use) as a measure for specific risk-taking behaviors (Ulleberg & Rundmo, 2003; Turner et al., 2004).

Unlike in the previous studies mentioned above, risk-taking behavior in this study is occupational. Awareness of safety and unsafe acts is important for helping to improve safety in the workplace. Geller (2005) suggested 7 dimensions to identify risk-taking and safe behaviors. These dimensions are (adapted from Geller, 2005):

(1) *Body positioning/protecting:* Positioning/protecting body parts (*e.g.*, avoiding line of fire, equipment guards, barricades, *etc.*).

(2) *Visual focusing:* Eyes and attention devoted to ongoing task(s).

(3) *Communicating:* Verbal or nonverbal interaction that affects safety.

(4) *Pacing of work:* Rate of ongoing work (*e.g.*, spacing breaks appropriately, rushing).

(5) *Moving objects:* Body mechanics while lifting, pushing/pulling.

(6) *Complying with lockout/tag-out:* Following procedures for lockout/tag-out.

(7) *Complying with permits:* Obtaining, then complying with permit(s). (*e.g.*, confined space entry, hot work, excavation, open line, hot tap, *etc.*)

In this study, risk-taking behavior was measured by observing the participants risk-taking behavior during a laboratory experiment and the responses from the risk-taking behaviors questionnaire. The risk-taking behavior observation list was developed from the review of many construction safety training documents and informative materials. The construction risk-taking behavior questionnaire was generated from interviews with the experts in construction and training documents from the Electronic Library of Construction Occupational Safety and Health (n.d.).

2.5 Culture

Culture plays an important role in how people perceive and live their lives. Culture may also influence people's risk perception and risk-taking behaviors. In this section, the definitions, components, and framework of culture are reviewed.

Culture has been defined by researchers in various ways in several social science disciplines such as anthropology, psychology, and sociology. Hofstede (2001) defines culture as "the collective programming mind that distinguishes the members of one group or category of people from another" (p.9) The mind means "thinking, feeling, and acting, with consequences of beliefs, attitudes, and skills" (Hofstede, 2001, p.10). Values, rituals, heroes, symbols, and practices form culture. Each of the elements of culture is explained as follows:

- *Values:* the society's beliefs of what is good, bad, right, and wrong (Deresky, 2000).
- *Rituals:* "collective activities that are technically unnecessary to the achievement of desired ends, but that within a culture are considered socially essential, keeping the individual bound within the norms of the collectivity" (Hofstede, 2001, p.10).
- *Heroes:* persons or imaginary characters whose characteristics are highly respected by the members of the society (Hofstede, 2001).

- *Symbols:* "words, gestures, pictures, and objects that carry often complex meanings recognized as such only by those who share the culture" (Hofstede, 2001, p.10).
- *Practices:* the perception of the culture by outsiders. Rituals, heroes, and symbols are part of the practices (Hofstede, 2001).

Researchers have developed various frameworks to examine how one culture is different from another. These frameworks represent a tendency of the majority of the population; it can not be used to stereotype how an individual from a particular culture would behave. Therefore, the study presented here will not categorize how people from a region or a country would behave; rather it will indicate the likeliness of people's behavior toward risk.

Among these different frameworks is the work of Hofstede, which has been used and referenced extensively, especially in cross-cultural research (Martin, 2003; Ottati et al., 1999; Smith et al., 1996). Hofstede (2001) identified five value dimensions to help classify and understand the national culture differences. Hofstede's value dimensions are predominately used to measure work-related values (Smith, Dugan, & Thrompenaars, 1996; Ottati, Triandis, & Hui, 1999). The first four dimensions were developed in the 1960s-1970s from the responses to a questionnaire of IBM's employees in 72 countries. The fifth dimension, whose scores were retrieved by using the Chinese Value Survey drawn from student samples in 23 countries, was identified in 1985.

The five dimensions are (1) power distance, (2) uncertainty avoidance, (3) individualism and collectivism, (4) masculinity and femininity, and (5) long term and short term orientation. The descriptions and details of each dimension are summarized in Table 2.2.

Dimension	Description	Key Differences	
		High Index	Low Index
Power Distance	"The extent to which the less powerful members of institutions and organizations within a country expect and accept that power is distributed unequally" (Hofstede, 2001, p.98).	▪ Big gaps in power and authority in the hierarchy ▪ Centralized decision making ▪ Powerful people have privilege ▪ Lower-rank people are expected to be told ▪ Subordinates try to avoid confrontation or disagreement with superiors (Ottati et al., 1999)	▪ Small gap in power and authority in the hierarchy ▪ Decentralized decision making ▪ Ability to consult between all personnel are important ▪ Lower-rank people are expected to be consulted ▪ Subordinates are not afraid of confrontation or disagreement with superiors (Ottati et al., 1999)
Uncertainty Avoidance	"The extent to which the members of a culture feel threatened by uncertain or unknown situations" (Hofstede, 2001, p.161).	▪ Fear of failure ▪ Preference for task with secure outcomes, no risks, and instructions ▪ Obey rules ▪ Uncertainty is a threat ▪ Only known risks are taken	▪ Hope of success ▪ Preference for tasks with uncertain outcomes, calculated risks, and require problem solving ▪ Break rules if necessary ▪ Uncertainty is accepted ▪ Willing to take unknown risks
Individualism and Collectivism	"Individualism stands for a society in which the ties between individuals are loose: Everyone is expected to look after him/herself and her/his immediate family only. Collectivism stands for a society in which people form birth onwards are integrated into strong, cohesive in-groups, which throughout people's lifetime continue to protect them in exchange for unquestioning loyalty" (Hofstede,	▪ Freedom and challenge jobs are important ▪ Earnings are more important than interesting works ▪ Communications are straightforward ▪ More control over jobs and working conditions ▪ Individual reward systems ▪ Emphasize on individuals' personal belief and needs (Ottati	▪ Training and skill jobs are important ▪ Interesting work as important as earning ▪ Communications are not straightforward, unspoken communications are important ▪ Less control over jobs and working conditions ▪ Group reward systems ▪ Emphasize on the views and

Dimension	Description	Key Differences	
		High Index	**Low Index**
	2001, p.225).	et al., 1999) ▪ Emphasize on personal pleasure and enjoyment over social duty (Ottati et al., 1999)	needs of the group (Ottati et al., 1999) ▪ Cooperate with members of the group (Ottati et al., 1999)
Masculinity and Femininity	"Masculinity stands for a society in which social gender roles are clearly distinct: Men are supposed to be assertive; women are supposed to be more modest, tender, and concerned with the quality of life. Femininity stands for a society in which social gender roles overlap: Both men and women are supposed to be modest, tender, and concerned with the quality of life" (Hofstede, 2001, p.297).	▪ Big gap between men and women ▪ Materialistic ▪ Low visibility of women at workplace ▪ Higher pay is preferred ▪ Live in order to work	▪ Men and women are not different ▪ Relationship and quality of life oriented ▪ High visibility of women at workplace ▪ Fewer hours are preferred ▪ Work in order to live
Long Term and Short Term Orientations	"Long Term Orientation stands for the fostering of virtues oriented towards future rewards, in particular, perseverance, and thrift. Its opposite pole, Short Term Orientation, stands for fostering of virtues to the past and present, in particular, respect for tradition, preservation of 'face' and fulfilling social obligations" (Hofstede, 2001, p.359)	▪ Leisure time is not important ▪ Future is important ▪ Structured problem solving ▪ Traditions are adaptable and can be changed ▪ Saving and investing ▪ Work is a central value of life (Ottati et al., 1999) ▪ Recognition and wealth are symbolized of success (Ottati et al., 1999). ▪ Gender-role differences at work are obvious (Ottati et al., 1999).	▪ Leisure time is important ▪ Past and present are important ▪ Fuzzy problem solving ▪ Traditions are important and should not be change ▪ Spending ▪ Work is not a central value of life (Ottati et al., 1999) ▪ Life style and contact with people are important (Ottati et al., 1999) ▪ Gender-role differences at work are small (Ottati et al., 1999)

Table 2.2: Hofstede (2001)'s dimensions, descriptions, and key characteristics.

Even thought Hofstede's framework has been used extensively by researchers, it also has been criticized in many aspects such as countries and population sampled. The countries Hofstede selected could affect development of the dimensions (Smith et al., 1996). The populations sampled were from the same cooperate culture and perhaps did not represent the national populations (Smith, et al., 1996). The concern is especially in developing countries where these workers were likely to belong to a higher level of wealth and social status.

The countries' scores on the first four of Hofstede's value dimensions are shown in Table 2.3. The last dimension, "long term and short term orientations," of these countries is not shown here because Hofstede did not provide the scores for all of the listed countries. Note that the countries listed here are located in the regions targeted for this study. Not all of the scores for the countries in Asia and Latin American are available. For North America, Canada's scores are not listed since the focus of this study is only within the U.S.

Country	Power Distance Index	Uncertainty Avoidance Index	Individualism/ Collectivism Index	Masculinity/ Femininity Index
North America				
United States	40	46	91	62
Far East Asia				
China+	80	30	20	66
Hong Kong	68	29	25	57
Indonesia	78	48	14	46
Japan	54	92	46	95
Malaysia	104	36	26	50
Philippines	94	44	32	64
Singapore	74	8	20	48
South Korea	60	85	18	39
Taiwan	58	69	17	45
Thailand	64	64	20	34
Vietnam+	70	30	20	40
Latin America				
Argentina	49	86	46	56
Brazil	69	76	38	49
Chile	63	86	23	28
Colombia	67	80	13	64
Costa Rica	35	86	15	21
Ecuador	78	67	8	63
Guatemala	95	101	6	37
Mexico	81	82	30	69
Panama	95	86	11	44
Peru	64	87	16	42
Salvador	66	94	19	40
Uruguay	61	100	36	38
Venezuela	81	76	12	73

+estimate value

Table 2.3: Hofstede's index scores for selected countries.
(adapted from Hofstede, 2001).

There was no evidence as to how the indices shown above may link to risk perception and risk-taking behavior. Uncertainty avoidance tended to be the dimension that could shed some light on this issue. People who have high uncertainty avoidance were expected take less risk than those who have low uncertainty avoidance. From Hofstede's indices, Americans appeared to take more risk than Latin Americans. However, it was contradicted by the fatality rates provided by the [d]ILO (2006) shown in Appendix A; the fatality rates in Argentina, Bolivia, Brazil, Columbia, Costa Rica, Honduras, Nicaragua, and Panama are mostly higher than in the U.S. ([d]ILO, 2006). Furthermore, there was a suggestion that other dimensions may be related to risk perception. Martin (2003) suspected that power distance and individualism dimensions might contribute to the differences in risk perception associated with hazard situations between American and Ghanaian workers. Without enough support as to which dimensions could predict individuals' risk perception and risk-taking behavior, this study included all five indices for exploration.

There have been some studies about whether people from different cultures perceive risks differently. Vredenburgh and Cohen (1995) studied risk perception among Caucasians, Mexican-Americans, Asian-Americans, and African-Americans. They asked participants to rate the risks they perceived in various situations. These situations include:

- Smoking
- Carrying weight up a ladder
- Riding in the bed of pick-up truck
- Going down a dark staircase
- Working with heavy machinery
- Riding a motorcycle without a helmet
- Using firearms
- Driving a car after drinking (2 drinks)
- Working with chemicals

Their study concluded that there are differences in risk perceptions among people from different cultures. They also found that women perceive these situations to have a higher risk level than men. This finding is also consistent with other studies (Vredenburgh & Cohen, 1995).

2.6 Acculturation

Redfield, Linton, and Herskovits (1936) proposed that "acculturation comprehends those phenomena which result when groups of individuals having different cultures come into continuous first-hand contact, with subsequent changes in the original cultural patterns of either or both groups" (p.149). Stephenson (2002) pointed out that even though this definition has been the most frequently used and adapted in the literature, there are discrepancies when it comes to actual measurement of acculturation. Major discrepancies are (1) the acculturation tools measured at the individual level instead of at the group or societal level, and (2) most measurement tools do not measure cultural changes (Stephenson, 2000). Marin (1992) suggested that the acculturation process can occur in three levels: the superficial, the intermediate, and the significant. The superficial level includes learning or forgetting facts about cultural history and tradition, changes in diet and uses of media. The intermediate level includes language use and preference, ethnicity of people that the individuals interact with, and their preferred ethnic media. The significant level measures the value, norms, and beliefs.

The existing tools measure acculturation in the areas of (1) language use, preference, and knowledge, (2) the use and preference of food and media, (3) cultural identity, behavior, knowledge, and value, (4) interaction with individual's culture and the culture of dominant society, (Stephenson, 2000; Zea, Asner-Self, Birman, & Buki, 2003). An individual who immerses into the dominant culture is identified as "acculturated" (or "assimilated"), the individual who remains in his/her own culture is identified as "traditional" (or "rejection"), while an individual who immerses in both cultures is identified as being "bicultural" (or "integration") (Berry, 1980; Landrine & Klonoff, 1994).

Acculturation research has been used and explored extensively in the field of psychology to help analyze an individual's behaviors and their ability to help identify the root causes of the problems (Landrine & Klonoff, 1994; Stephenson, 2000). Acculturation can also be used as a framework to help us understand the differences between and within ethic groups (Stephenson, 2000). In the present study, acculturation was used to ensure that the participants can represent their cultures (American, Asian, or Latin American). The questions used to obtain the individual's acculturation level were adopted from the Stephenson Multigroup Acculturation Scale (SMAS). SMAS is a tool that measures the individuals' behavior, language, and knowledge of the culture of both their origin and the dominant society. Dominant society immersion (DSI) measures the immersion of the individual into the dominant culture, while the ethnic society immersion (ESI) measures the individual's retention of the culture of origin. Thus SMAS can be used with individuals from all the groups instead of measuring one specific group like most of the acculturation tools. However, by using a scale that can measure all groups of people, this study gave up the ability to be able to measure the acculturation at a significant level.

2.7 Locus of Control

The locus of control is another factor that can alter the individual's risk perception and risk-taking behavior. Julian Rotter developed the locus of control concept from the social learning theory. Rotter (1966, p. 1) described the locus of control as follows:

> When a reinforcement is perceived by the subject as following some action of his own but not being entirely contingent upon his action, then, in our culture, it is typically perceived as the result of luck, chance, fate, as under the control of powerful others, or as unpredictable because of the great complexity of the forces surrounding him. When the event is interpreted in this way by an individual, we have labeled this a belief in external control. If the person perceives that the event is contingent upon his own behavior or his own relatively permanent characteristics, we have termed this a belief in internal control.

Locus of control is "the degree to which an individual perceives that the consequences of behavior and life events are in his or her control" (Wueber, 1985). Internal locus of control individuals view that their behaviors contribute to the consequences, while external locus of control individuals view that the consequences happen beyond their personal control. An internal locus of control individual takes personal responsibility for his/her accidents while an external locus of control individual blames it on uncontrollable factors or outside forces (Jones & Wueber, 1985). An external locus of control individual does not view the accident as his/her fault. Researchers have studied locus of control with risks in various situations such as driving, health risk, sexual risk-taking behavior, and adolescent risk-taking behavior.

Researchers have reported that an internal locus of control individual tends to take fewer risks than external locus of control individuals. Montag and Comrey (1987) have reported that external locus of control individuals are involved in more accidents. Martin (2002) concluded from her study that individuals with a higher internal locus of control are more likely to look for and comply with hazard warnings. Salminen and Klen (1994) investigated locus of control and risk-taking behavior among forestry and construction workers. They found that internal locus of control workers tend to take fewer risks in their jobs. Wuebker (1986) found that internal locus of control employees are likely to have fewer accidents and injuries at work than their external counterparts.

Even though many studies have suggested that internal locus of control individuals tend to take less risk than the external locus of control individuals, there are also many studies that were unsuccessful in identifying the relationship between locus of control and risk. For example, Iversen and Rundmo (2002) could not suggest whether or not there is a relationship between locus of control and risky driving, or accidents. No relationship was found in the study conducted by Rolison and Scherman (2002), which investigated the relationship of risk-taking behavior and locus of control among adolescents. Crisp and Barber (1995) investigated the effect of locus of control on risk perception and sexual risk-taking behavior among young drug users. They found that people with an internal locus of control realized that they were taking risks with their own decisions, while those with an external locus of control felt that they were not in danger with such risks. However, the individual's awareness of the risk could not predict the level of their risk-taking behaviors. These studies suggest that measurements and analysis of locus of control effects is not easy. Selecting the right measurement tool for the situation is very important.

Researchers have developed many scales in an attempt to measure locus of control. Rotter (1966) developed an Internal-External Locus of Control Scale (I-E Scale) to measure people's general locus of control. It consists of 29 items. Each item has 2 statements that indicate an internal and external locus of control. Under each item, respondents are forced to choose one statement or another. Rotter's I-E Scale is the most well-known, cited and used locus of control scale (Fournier & Jeanrie, 2003; Iversen & Rundmo, 2002). Another well-known locus of control scale was developed by Levenson (1981). The Internality, Powerful Others, and Chance Scales (IPC Scale) consists of 8 items of each subscale (internality, powerful others, and chance) which made up 24 total items. Levenson (1981) believed that the IPC scale captures the two types of external locus of control, chances and powerful others that Rotter's I-E Scale cannot.

Many researchers have also developed a locus of control scale that is situation-specific, which has been claimed to be a better predictor of a specific behavior than the general scale (Jones & Wuebker, 1985; Spector, 1988). For example, the Safety Locus of Control Scale (SLC Scale) was developed to predict workers' accidents and injuries (Jones & Wuebker, 1985). Paulhus and Christie (1981) developed the Spheres of Control Scale that captures personal, interpersonal, and sociopolitical spheres of control. Montag and Comrey (1987) developed the Driving Internality and Driving Externality Scale to capture drivers' locus of control. Spector (1988) developed the Work Locus of Control Scale to capture the locus of control that was related to workplace. Items selected and modified from the IPC Scale (Levensen, 1981) and the SLC scale formed a locus of control questionnaire for the current study.

2.8 Self-Efficacy

Self-efficacy emerges from social learning theory. It was first introduced by Bandura in 1977. Self-efficacy is individuals' beliefs about their capabilities to carry out actions that result in specific performance (Bandura, 1994; Pajares, 2002). These beliefs influence the individuals' goals, self-determination in reaching these goals, and problem-solving activities (Murdock, Wendler, Nilsson, 2005). The emphasis is on the beliefs, not the actual capability of the individuals. Self-efficacy affects all aspects of behaviors including the individual's effort and determination to perform a task (Dejoy, 1999). People with high self-efficacy view difficult tasks as challenging instead of threatening (Bandura, 1994). They approach difficult situations with assurance. They feel accomplished and satisfied with themselves. If failure occurs, they believe that it happens because of insufficient knowledge and skills. Failure on tasks does not harm their self-confidence. They have less stress, and a lower vulnerability to depression. On the other hand, people with low self-efficacy lack self-confidence, aspiration, and commitment to goals (Bandura, 1994). They view difficult tasks as threats and approach them with a pessimistic attitude. It does not take much of a failure to reinforce doubts about their capabilities.

Individuals develop self-efficacy through their life experiences. Success and failure, observation of others, social persuasion about individuals' capabilities and inferences from somatic and emotional states help shape individuals' self-efficacy (Bandura, 1994). Self-efficacy affects "life choices, quality of functioning, resilience to adversity, and vulnerability to stress and depression" (Bandura, 1994, p. 81).

Self-efficacy has been found to be a powerful predictor in health risk behaviors such as alcohol consumptions, drugs, sexual risk behaviors, and smoking. It also has been investigated in high risk sports research (Slanger & Rudestam, 1997). Bandura (1994) suggested that people with higher self-efficacy are healthier and less likely to engage in health impairing habits. Self-efficacy has been noted to influence how people perceive warnings. It has been suspected that people with low self-efficacy are less likely to comply with warnings (Dejoy, 1999).

Many self-efficacy researchers have developed their own scales to measure self-efficacy in their research areas. Murdock, Wendler, and Nilsson (2005) developed a self-efficacy scale for addiction counseling by using the national competencies for addiction counseling, and counseling self-efficacy research and theory. Other researchers have ensured that the scales they developed are consistent with Bandura's suggestion. Martin, Wilkinson, and Poulos (1995) developed a drug avoidance self-efficacy scale. Perraud (2000) developed a scale to measure depression coping efficacy. Both of these scales claimed to be consistent with Bandura's idea, in that they measure the confidence of the participants to avoid drugs or to cope with depression. Slanger and Rudestam (1997) developed a physical self-efficacy scale based on Bandura's concept. Participants were asked questions concerning confidence in (1) performing, (2) managing fear, (3) avoiding making a mistake, (4) handling whatever anyone else with their experience can handle, (5) dealing with an unexpected event, and (6) accomplishing what they set out to do regardless of physical risk. Sherer and Maddux (1982) developed general and social self-efficacy scales. Their intention was to create scales that were not tied to specific situations. In this way, the general self-efficacy of participants can be measured. Items from Sherer and Maddux (1982)'s general self-efficacy scale were selected for this study.

2.9 Accident Prevention

Researchers study risk and accidents to gain a better understanding of how accidents occur and to continue to suggest methods to reduce and prevent accidents. Lund and Aaro (2004) proposed an accident prevention model presented in Figure 2.2

that focuses on human, structural, and cultural factors. The concept behind this model is that attitudes, behavior, and structural conditions influence two risk factors, (1) behavior and (2) physical and organization environment, and two process factors, (1) attitudes and beliefs, and (2) social norms and culture, that lead to accidents and injuries. They suggested that modification of the three elements that influence risk factors and process factors would help prevent accidents and injuries.

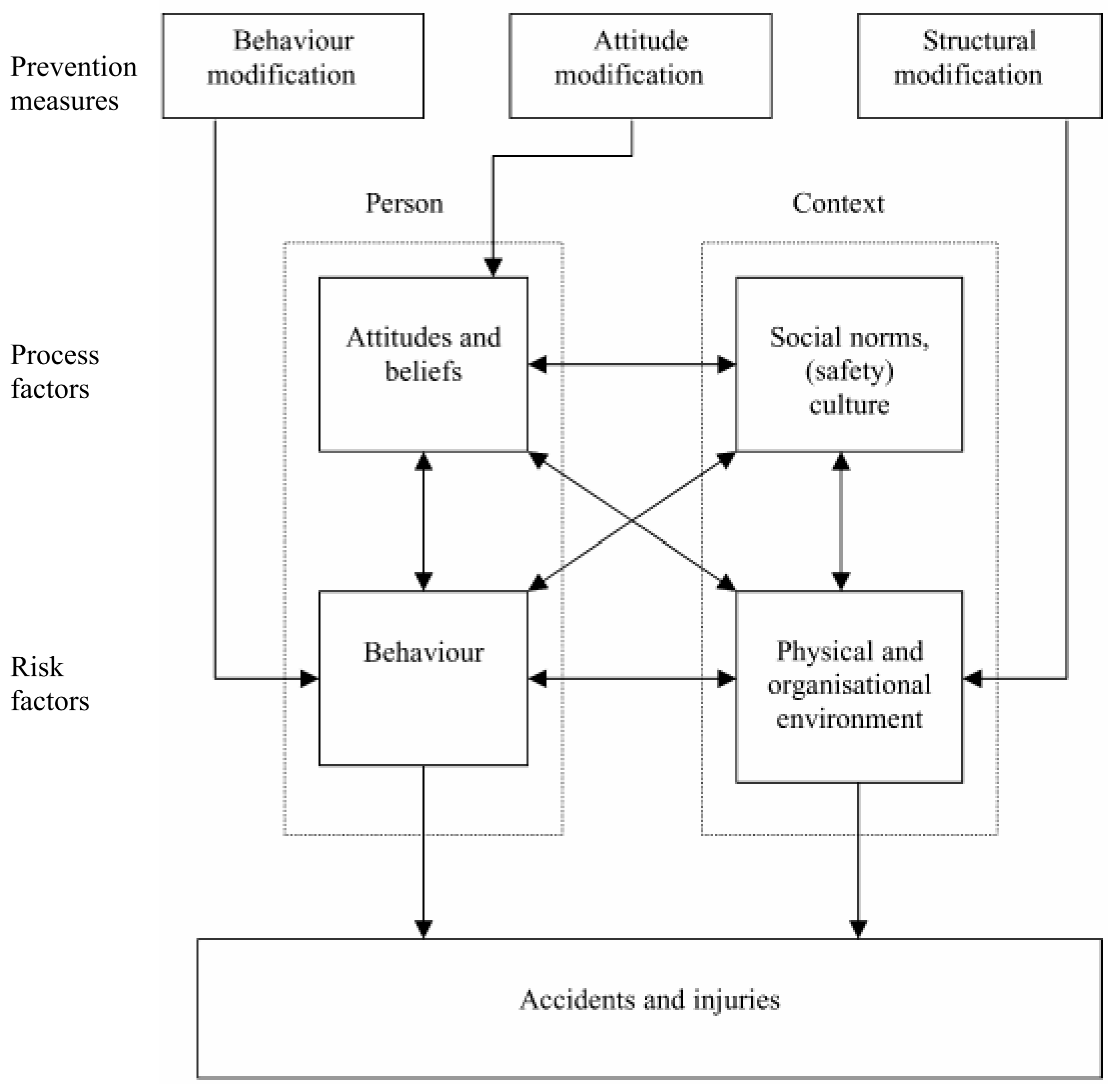


Figure 2.2: An accident prevention model developed by Lund and Aaro (2004, p.275).

The prevention measures which are the key drivers of preventing accidents are explained below (Lund & Aaro, 2004):

(1) Behavior modification: changing behavior without trying to influence attitudes or assuming that attitudes have to be changed to change behavior. Some examples of this

modification are skill training, feedback that focuses on behavior, and rewards for desired behaviors.

(2) Attitude modification: changing attitudes with information and persuasion. An example of the procedures is persuasion through mass media campaigns.

(3) Structural modification: “changing the organizational and social context through legislation, organization and economy” (Lund & Aaro, 2004, p.275). This includes changing physical environment and availability of products.

Lund and Aaro (2004) suggested that attitude modification seems to be less effective than structural modification. Combination programs (that combined these elements) are even more effective, especially the ones that include social norms and cultural factors rather than having an effect only at the individual level.

Chapter 3: Methodology

The research methodology for this study consisted of the following phases: a pilot studies, a recruiting process, pre-experiment questionnaires, an experiment, a post-experiment questionnaire, and a post-experiment interview. Since this study was a cross-cultural study, it is important to disclose that the researcher was Asian and a citizen of Thailand.

3.1 Independent and Dependent Variables

As mentioned earlier, this study had three independent variables and two dependent variables. The three independent variables were the cultures (American, Asian, and Latin American), the reward systems (rewards, penalty, and none), and traits (risk perception, locus of control, and self-efficacy). The two dependent variables were risk-taking behavior and performance (quality and time). Participants' cultures and traits were classified as non-manipulated variables because they could not be assigned by the researcher. On the other hand, the reward system was a manipulated variable.

The three reward systems were as follows with more details given in Appendix J:

- *Rewards:* The quality of the finished task and the time taken to finish the task were used to determine the winners. The participants with the top three scores received \$50, \$30, and \$10, respectively.
- *Penalty:* The quality of the finished task and the time taken to finish the task were used to determine the penalty. The maximum penalty possible was \$10.
- *None:* No reward or penalty was offered in this task.

3.2 Experimental Design

This research used a mixed factor experimental design. Within each culture group, this study used a within-subject design. For between culture groups, a between-subject design was used. This means that each participant was exposed to all three types of reward systems used in this study (reward system was a within subject factor, culture was a between-subject factor). Because each participant is exposed to all types of experimental conditions, one condition may affect another and therefore affect the results of the study. This is known as a sequence effect. There are two major types of sequence effects: practice and carry-over (Graziano & Raulin, 2000). The practice effect occurs when participants learn during the experiment. A carry-over effect occurs when an experimental condition affects the results of the next experimental condition. Graziano and Raulin (2000) recommended two general methods to control sequence effects: (1) holding the unrelated variables of the study constant, and (2) alternating the order of the experimental conditions. For the first method, researchers can provide training about the tasks to reduce the effects of learning during the study. Also, resting between each task prevents participants from becoming fatigued from the experiment. Therefore, task training and rest periods were provided to the participants for the current study. For the second control method, counterbalancing was used. Counterbalancing is a systematic arrangement of the experimental condition orders. Counterbalancing ensures that all possible orders are present. There are three types of experimental conditions (reward systems). At least 6 participants (3x2x1 = 6 possible orders) were needed to control the sequence effect from the experiment. There were three cultures. Two replications were used to decrease errors in the experiment. Therefore, the total number of participants required was 36: (6 for each culture group) x (3 culture groups) x (2 replications). The overall design and the total amount of data collected are shown in Table 3.1. Reward systems orders are presented in Table 3.2. Note that "1" stands for rewards, "2" stands for penalty, and "3" stands for none.

	Reward systems (Within-Subject)		
Cultural Background (Between-Subject)	Rewards	Penalty	None
American	12	12	12
Asian	12	12	12
Latin American	12	12	12

Table 3.1: Amount of data to be collected.

Combination	Order 1	Order 2	Order 3
1	1	2	3
2	3	1	2
3	2	3	1
4	1	3	2
5	2	1	3
6	3	2	1

Table 3.2: Six possible orders of reward systems.

Each participant performed three reward systems under three different tasks. The order of experiments and participants were assigned using Latin squares. The restriction of Latin squares is that each incentive only appears once in each row and once in each column. Within each cultural group, there were 4 sets of Latin squares. Tasks were assigned to the reward systems by using Greaco-Latin squares. Greaco-Latin squares not only restricted the tasks to appear once in each column and each row, they also provided the restriction that tasks can only appear once with each incentive within each Latin square. Regarding the order of reward systems, there were six possible combinations of tasks that could be executed that met the Greaco-Latin square's requirements. Table 3.3 presents 6 combinations of the tasks. Figure 3.1 shows the combinations of reward systems and tasks that were randomly assigned to each cultural group. Note that "1" stands for rewards, "2" stands for penalty, "3" stands for none, "A" stands for task A, "B" stands for task B, and "C" stands for task C.

Combination	Order 1	Order 2	Order 3
1	A	B	C
	B	C	A
	C	A	B
2	A	C	B
	C	B	A
	B	A	C
3	B	C	A
	C	A	B
	A	B	C
4	B	A	C
	A	C	B
	C	B	A
5	C	A	B
	A	B	C
	B	C	A
6	C	B	A
	B	A	C
	A	C	B

Table 3.3: Six possible task combinations.

Americans	1A	2B	3C	1C	2B	3A
	3B	1C	2A	3B	1A	2C
	2C	3A	1B	2A	3C	1B
	1B	3C	2A	1C	3A	2B
	2C	1A	3B	2A	1B	3C
	3A	2B	1C	3B	2C	1A
Asians	1B	2A	3C	1B	2C	3A
	3A	1C	2B	3C	1A	2B
	2C	3B	1A	2A	3B	1C
	1A	3C	2B	1B	3A	2C
	2C	1B	3A	2A	1C	3B
	3B	2A	1C	3C	2B	1A
Latin Americans	1C	2A	3B	1A	2C	3B
	3A	1B	2C	3C	1B	2A
	2B	3C	1A	2B	3A	1C
	1A	3B	2C	1C	3B	2A
	2B	1C	3A	2B	1A	3C
	3C	2A	1B	3A	2C	1B

Figure 3.1: Reward systems and tasks combinations.

The combinations of reward systems and tasks were randomly assigned to the participants within each culture. As participants arrived at the research site, the researcher used Table 3.4 to assign the reward systems and tasks to participants.

Participants	Order 1	Order 2	Order 3
Americans			
1	1c	2b	3a
2	3b	2c	1a
3	2a	3c	1b
4	2a	1b	3c
5	1b	3c	2a
6	2c	1a	3b
7	3a	2b	1c
8	3b	1a	2c
9	1c	3a	2b
10	2c	3a	1b
11	3b	1c	2a
12	1a	2b	3c
Asians			
1	3c	2b	1a
2	2c	3b	1a
3	3c	1a	2b
4	3b	2a	1c
5	1b	2a	3c
6	3a	1c	2b
7	1b	2c	3a
8	1a	3c	2b
9	1b	3a	2c
10	2c	1b	3a
11	2a	3b	1c
12	2a	1c	3b
Latin Americans			
1	3A	1B	2C
2	3C	1B	2A
3	1A	3B	2C
4	3A	2C	1B
5	3C	2A	1B
6	1A	2C	3B
7	2B	1A	3C
8	2B	1C	3A
9	1C	3B	2A
10	2B	3A	1C
11	2B	3C	1A
12	1C	2A	3B

Table 3.4: Randomly assigned reward systems and tasks.

3.3 Data Collection Procedure

Overview of the data collection procedure is presented in Figure 3.2. The details of the steps are covered in the following sections.

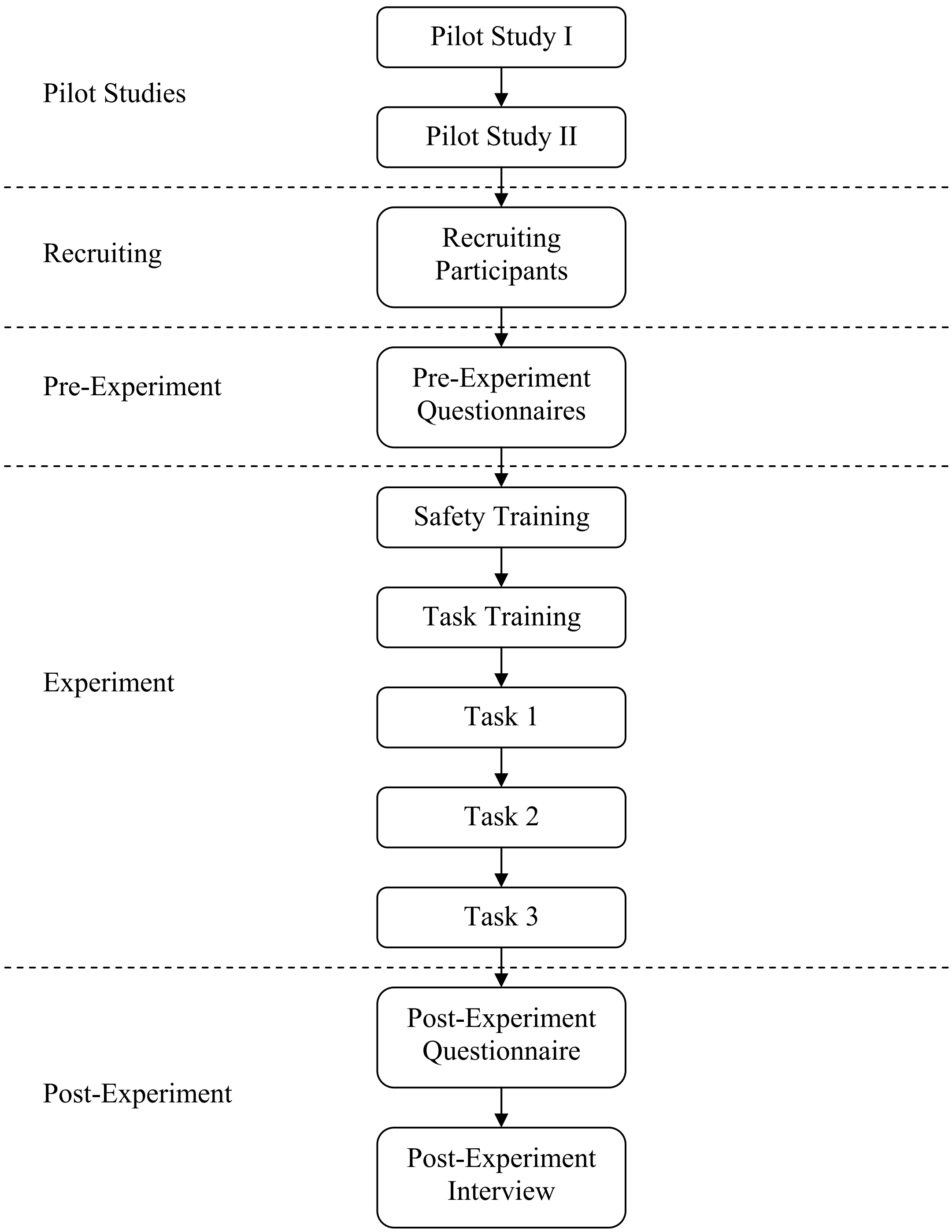


Figure 3.2: Overview of the data collection procedure.

3.4 Pilot Studies

Two pilot studies were conducted to identify areas of improvement for all of the tools used to collect the data. The tools include questionnaires, interview questions, experimental protocol, task training, and safety training, and were tested to ensure their validity and reliability. The tasks were tested to increase the researcher's confidence that the data could be collected. The challenge of this study was that risks had to be introduced in the study, while at the same time it was unethical to put participants in an unsafe situation. Also, all studies conducted by Virginia Tech faculty, staff, and students involving human subjects must be approved by the Institutional Review Board (IRB) at Virginia Tech to ensure the research does not violate human rights and maintains safety for the participants. Researchers are required to follow ethical principles described in the Belmont Report and comply with federal regulations (Institutional Review Board, n.d.). Therefore before the pilot studies and the actual study were conducted, requests for approvals were submitted to the IRB.

For pilot study I, five participants, consisting of two Americans, two Asians, and one Latin American were recruited. The training task and the three tasks used for pilot study I is presented in Appendix B. The participants were required to use a hammer and nails to complete the training task and the three experimental tasks. The training task was designed for participants to practice how to build the materials from the diagrams provided, so that learning between tasks would be minimized. The results showed that the differences between participants' risk-taking behaviors were small. The possibility of risk-taking behaviors was small and the complexity of the tasks was low. Therefore, the researcher redesigned the tasks to increase the possibility of risk-taking behaviors and the complexity of the tasks. Cutting (by using a handsaw), drilling, and driving screws (by using a power drill) were added to the experiment. Pilot study II was conducted to test these new tasks. Four participants were recruited for pilot study II. The results indicated that the tasks showed promise for differentiating risk-taking behaviors between participants. Therefore these tasks were used during the actual experiment (the training and the experimental tasks are presented later in this chapter). Improvements were also made to the experiment protocol, questionnaires, interview questions, and safety training during pilot studies I and II.

3.5 Recruiting Participants

Participants were recruited from the Virginia Tech-Blacksburg campus community, which holds a mixture of international individuals (mainly students) from Asia and Latin America, and also because they were accessible. The Institutional Research and Planning Analysis at Virginia Tech (2006) reported that there were 706 Asians and 121 Latin Americans from targeting countries enrolled at Virginia Tech in Fall 2006. Moreover, Asian and Latin American construction workers were not available at the research site. Traveling to conduct the experiment overseas was not an option due to budget limitations. Participants were recruited via flyers, emails, and personal contacts. Participants filled out a screening questionnaire, shows in Appendix C. This questionnaire was used to gather information about the participants to ensure that the participants met the criteria required for the experiments. Information about the participants' demographics and acculturation was obtained. Note that Stephenson's (2000) SMAS was used in acculturation section. The next sections describe participants' criteria required for this study.

Participants' Gender

This research was targeted towards the male population. [d]ILO (2006) reported the number of women in construction around the world and is shown in Appendix D. The percentage of women working in the construction industry is 9-10% in the U.S., 7-10% in Asia, and 2-5% in Latin America. Note that these are the women working in the construction industry and are not construction workers. It is suspected that this percentage will be less for the construction occupation. For example, the U.S. Bureau of Labor Statistics (2006) reported that in 2005, women represented only 3% of the construction and extraction occupations, and 9.6% in the construction industry. With such a small percentage of women in the construction industry, women would only have accounted for 0.24-1.2 participants out of the 12 participants required for each culture group. To reduce the variations caused by gender differences, this study only recruited male participants, which represent most of the construction occupation. Also, since no study has been previously conducted to investigate this issue, the researcher was focused on using the majority of the population in the construction industry.

Future studies could investigate the same issue for female construction workers. By restricting participants' gender, the external validity of this research is only applied to male construction workers.

Participants' Age

The age of participants was limited to 18-35. The purpose of this criterion was to narrow age variation among participants.

Participants' Experience in Construction Industry

Participants recruited for this study were naive participants. This means that they were not full-time construction workers. However, the participants could have up to 3 months of experience working in construction.

Participants' Nationalities and Cultural Exposure

American participants were individuals who identified themselves as a U.S. citizen and had a high score in the dominant society immersion (DSI>3.683) and a low score in the ethnic society immersion (ESI<2.668). Asian participants were individuals who identified themselves as a citizen of Brunei, Burma, Cambodia, China, Hong Kong, Indonesia, Japan, Laos, Malaysia, Philippines, Singapore, South Korea, Taiwan, Thailand, or Vietnam, and had a high ESI score (ESI>3.534). The Latin American participants were individuals who identified themselves as a citizen of Argentina, Belize, Bolivia, Brazil, Chile, Columbia, Costa Rica, Dominican Republic, Ecuador, El Salvador, French Guiana, Guatemala, Guyana, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay, or Venezuela. Latin American participants either (1) had an ESI score higher than 3.642 or (2) had an ESI score between 3.00 and 3.642 and had lived in his native country for at least 75% of his life and had lived in the U.S. less than 25% of his life. Note that DSI and ESI cut off scores were based on the results of a SMAS survey distributed to various universities around the U.S. The survey responses were retrieved from 54 Americans, 76 Asians, and 23 Latin Americans.

3.6 Main Data Collection Process

In this section, pre-experiment, experiment, and post experiments phases are described.

3.6.1 Pre-Experiment

An informed consent form was sent to the qualified participants. The form contained the details of the research including the purpose, the procedure, benefits, participants' risk in participating, compensation, and confidentiality of the participants. Appendix E shows the informed consent form. Participants then took the pre-experiment I questionnaire online. The pre-experiment I questionnaire is shown in Appendix F. The questionnaire was completed before participants arrived at the research site. It asked participants about their general risk perception, construction risk perception and risk-taking behavior. Eighteen questions of the general risk perception questionnaire were adopted from the work of Leonard and his co-authors (as shown in Table 2.1). These questions were selected based on the items that appear on at least 2 out of 3 of the papers, and 2 items were included because they were work-related questions. Four questions were added from the work of Vrendenburgh and Cohen (1995), which made up 22 total questions for the general risk perception questionnaire. The construction risk perception and construction risk-taking behavior questions were generated from interviews with the experts in construction and training documents from the Electronic Library of Construction Occupational Safety and Health (n.d.).

Participants arrived at the research facility to conduct the laboratory experiment. Participants were asked to complete pre-experiment II questionnaire as shown in Appendix G. Information about locus of control, self-efficacy, and the culture of the participants were obtained. Items selected and modified from the IPC Scale (Levensen, 1981) and the SLC scale formed a locus of control questionnaire. Note that items 1, 6, 7, 8, 10, 13, 14, and 15 on the locus of control questionnaire measure internal locus of control and the other eight items measure external locus of control. Items from Sherer and Maddux (1982)'s general self-efficacy scale were selected for this study. For the culture dimension, participants were asked to respond to 20 culture related questions developed by Hofstede (2001). The participants' responses were calculated to identify the power distance index (PDI), the uncertainty avoidance index (UAI), the individualism index (IDV), the masculinity index (MAS), and the long-term orientation (LTO) of the individuals. These indices were calculated by the formulas, as follows (Hofstede, 2001):

$$PDI = -35m(03) + 35m(06) + 25m(14) - 20m(17) - 20$$
$$UAI = 25m(13) + 20m(16) - 50m(18) - 15m(19) + 120$$
$$IDV = -50m(01) + 30m(02) + 20m(04) - 25m(08) + 130$$
$$MAS = 60m(05) + 20m(07) + 20m(15) - 70m(20) + 100$$
$$LTO = -20m(10) + 20m(12) + 40$$

3.6.2 Experiment

Before the experiment was conducted, the researcher trained the participants on the safety in performing the experiment. Appendix H shows the safety training that was used by the researcher. Note that the training was in a PowerPoint presentation format with a narrator reading the safety training to the participants accompanied by pictures. Then, the researcher provided the participants with a training task to reduce learning during the experiments. The task helped participants become trained on the skills required during the actual experiments including reading the diagrams, and operating/using the tools. The training task shown in Figure 3.3 along with the diagram presented in Appendix I were given to the participants. The researcher then informed the participants about the criteria used to measure their performance. The experiment protocol and the performance measurement criteria are presented in Appendix J and K accordingly.

Figure 3.3: Training task.

The researcher then informed the participants again (after the participants were informed when they signed the inform consent form) that the experiment would be recorded with two webcams including the interview at the end of the experiment. Participants then performed three experimental tasks presented in Figure 3.4, Figure 3.5, and Figure 3.6. The diagrams of these three tasks are presented in Appendix L. Note that there was a 5 minute break between each task to help reduce fatigue. The three reward systems were explained to the participants. The three reward systems are presented in Appendix J (part of experiment protocol). The researcher observed and gathered data on the participants' risk-taking behavior and performance (time and quality). The observation sheet is presented in Appendix M.

Figure 3.4: Experimental task A.

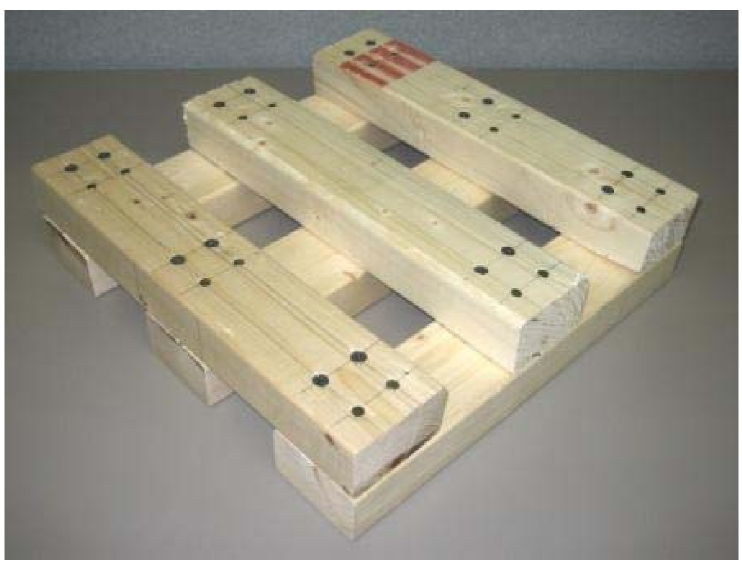


Figure 3.5: Experimental task B.

Figure 3.6: Experimental task C.

3.6.3 Post-Experiment

After the participants completed the three experimental tasks, they were then presented with a post-experiment questionnaire as presented in Appendix N. The questionnaire was composed of questions about the participants' behaviors and thoughts while performing the tasks. Risk perception of the participants' risk-taking behavior during the experiment was also obtained. Next, participants were interviewed to evaluate their perceptions about their performance and behaviors while performing the tasks. The interview questions are presented in Appendix O. Note that the interview questions were used as a guideline, with the researcher also probing participants to elaborate upon their answers. Then the participants' work was evaluated by the guidelines presented in Appendix P. After all experiments were completed, the researcher contacted the participants with the top three scores to give them the rewards.

3.7 Materials and Equipment

The materials and equipment used in this study were a hammer, a power drill, a hand saw, nails, screws, drill bits, a square, clamps, wood, nails, a tape measure, and a ruler.

Chapter 4: Results

4.1 Participants

There were 43 American, 25 Asian, and 18 Latin American applicants. Out of this pool of applicants, participants were selected based on the criteria described in section 3.5. The criteria are summarized below:

- Male
- 18-35 years old
- Maximum of 3 months of experience in the construction industry
- Countries of citizenship
    - An American participant had to be a U.S. citizen
    - An Asian participant had to be a citizen of Brunei, Burma, Cambodia, China, Hong Kong, Indonesia, Japan, Laos, Malaysia, Philippines, Singapore, South Korea, Taiwan, Thailand, or Vietnam,
    - A Latin American participant had to be a citzen of Argentina, Belize, Bolivia, Brazil, Chile, Columbia, Costa Rica, Dominican Republic, Ecuador, El Salvador, French Guiana, Guatemala, Guyana, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay, or Venezuela.
- Cultural exposure
-
    - An American participant had DSI>3.683 and ESI<2.668.
    - An Asian participants had ESI>3.534
    - A Latin American participant had either (1) ESI> 3.642 or (2) ESI score between 3.00 and 3.642 and had lived in his native country for at least 75% of his life and had lived in the U.S. less than 25% of his life.

4.1.1 Participants' Gender

As mentioned earlier, this study included only male participants.

4.1.2 Participants' Age

Average, standard deviation, and distribution of participants' age are presented in Table 4.1, Figure 4.1, and Figure 4.2. The participants were selected randomly. American participants, on average, were younger than Asian and Latin American participants.

Culture	Number of Participants	Mean	Standard Deviation
American	12	21.92	4.23
Asian	12	27.83	4.49
Latin American	12	27.33	4.64
All	36	25.69	5.11

Table 4.1: Participant age mean and standard deviation.

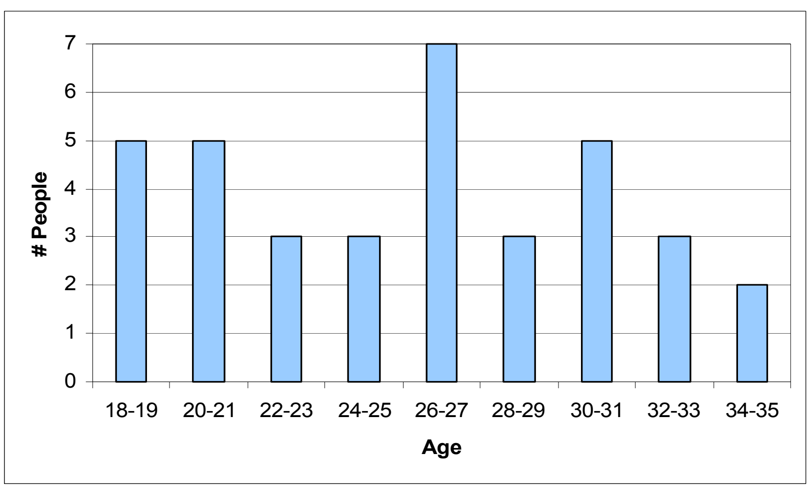


Figure 4.1 Overall frequency distribution of age.

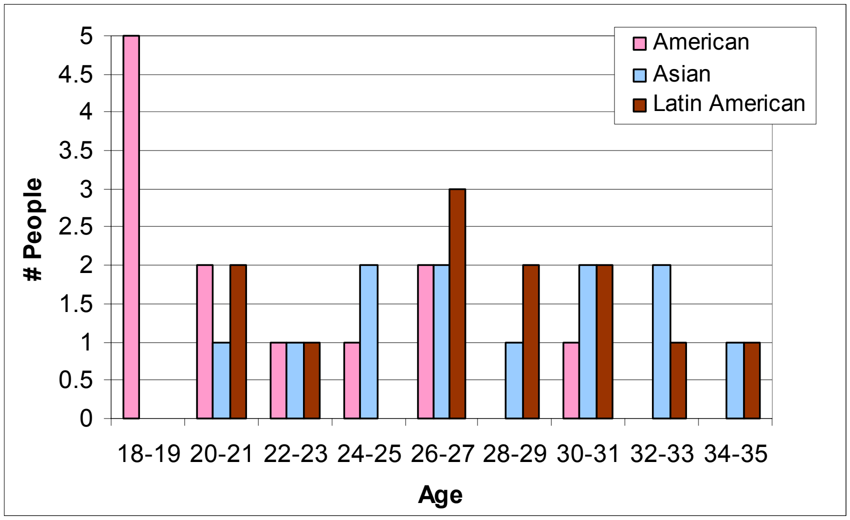


Figure 4.2: Participant age distribution by culture.

4.1.3 Participants' Experience

One of the participant criteria for this study was that a participant could have up to 3 months of experience working in construction. The majority of the participants had no experience in the construction industry. There was one participant from each culture who had 2 to 3 months experience.

4.1.4 Participants' Country of Citizenship

Participants from China made up the majority of the Asian participants, while Latin American participants came from a mixture of countries in Central and South America. Details of the country distributions are shown below in Figure 4.3.

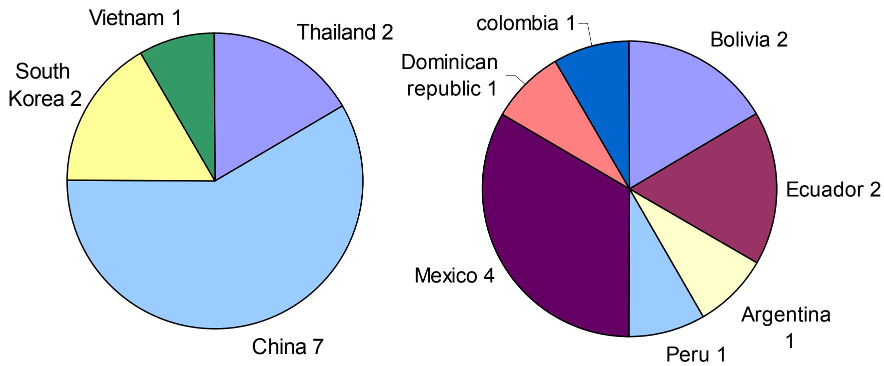


Figure 4.3: Countries of citizenship distributions of Asian and Latin American participants.

4.1.5 Cultural Exposure

The study was conducted at the main campus of Virginia Tech which is located in Blacksburg, Virginia. Participants were students, alumni, or instructors at Virginia Tech. Therefore, all Asian and Latin Americans participants had been exposed to American culture. The participants' DSI and ESI scores, along with the mean and standard deviations for the number of years that the participants had been in the U.S. are shown in Table 4.2. DSI measures the immersion of the individual into the dominant culture, while ESI measures the individual's retention of the culture of origin (Stephenson, 2000). Figure 4.4 shows the distribution of the number of years that Asian and Latin American participants lived in the U.S. Participants' scores on Hofstede's five cultural dimensions are shown in Table 4.3.

	DSI mean (SD)	ESI mean (SD)	Mean for years living in the U.S. (SD)
American	3.9111 (0.0821)	2.0588* (N/A)	N/A
Asian	2.6170 (0.5660)	3.7500 (0.1400)	3.7875 (3.1183)
Latin American	2.8056 (0.5230)	3.4044 (0.3333)	2.9792 (2.5010)

*There is only one ESI score for American participants.

Table 4.2: Number of years living in the U.S., DSI, and ESI scores.

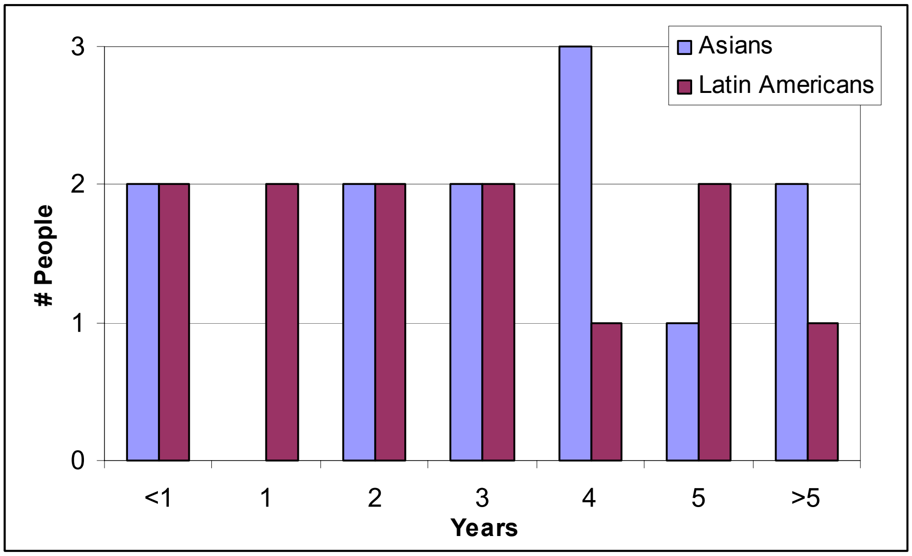


Figure 4.4: Distributions of number of years Asian and Latin American participants have lived in the U.S.

Culture	PDI Mean (SD)	UAI Mean (SD)	IDV Mean (SD)	MAS Mean (SD)	LTO Mean (SD)
American	2.9167 (56.3857)	40.8333 (70.0595)	95.4167 (41.8036)	162.5 (77.0035)	65 (29.6954)
Asian	62.5 (29.5804)	30 (54.9733)	70.8333 (41.0007)	80.8333 (89.8947)	41.6667 (18.0067)
Latin American	29.5833 (45.1492)	57.5 (63.1916)	85 (36.0555)	143.3333 (78.5474)	38.3333 (30.1008)

Table 4.3: Participants' scores on Hofstede's cultural dimensions.

A two-sample Welch t-test was used to identify cultural dimension differences among participants. The testing statistics shown below were used:

H_0: $\mu_1 = \mu_2$ versus H_1: $\mu_1 > \mu_2$

$$W_o = \frac{\overline{y_1} - \overline{y_2}}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

The rejection rule was to reject H_0 if $W_0 > t\ df_s, \alpha$ where,

$$df_s = \frac{\left(\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}\right)^2}{\frac{\left(\frac{S_1^2}{n_1}\right)^2}{n_1 - 1} + \frac{\left(\frac{S_2^2}{n_2}\right)^2}{n_2 - 1}}$$

The results of the test are presented in Table 4.4. The results are discussed in the next chapter.

Cultural Dimensions	**Alternative Hypotheses (H1: µ1 > µ2)**	W_0	df_s	$t_{dfs,0.05}$	**Decision**
PDI	Asian > Latin American	2.1125	18	2.1009	Reject H_0
	Latin American > American	1.2788	20	2.0860	Accept H_0
	Asian > American	3.2416	16	2.1199	Reject H_0
UAI	Latin American > American	0.6119	21	2.0796	Accept H_0
	American > Asian	0.4214	20	2.0860	Accept H_0
	Latin American > Asian	1.1373	21	2.0796	Accept H_0
IDV	American > Latin American	0.6536	21	2.0796	Accept H_0
	Latin American > Asian	0.8988	21	2.0796	Accept H_0
	American > Asian	1.4544	21	2.0796	Accept H_0
MAS	American > Latin American	0.6036	21	2.0796	Accept H_0
	Latin American > Asian	1.8136	21	2.0796	Accept H_0
	American > Asian	2.3901	21	2.0796	Reject H_0
LTO	American > Asian	2.3275	18	2.1009	Reject H_0
	Asian > Latin American	0.3292	17	2.1098	Accept H_0
	American > Latin American	2.1847	21	2.0796	Reject H_0

Table 4.4: Cultural dimension testing results.

4.2 Risk-Taking Behavior Data

Risk-taking behaviors were assessed and ranked by activity. Each activity was weighted by the probability of the participants to perform the activity. The score for each risk-taking behavior = risk level x probability of each activity. There were three potential risk levels defined for this study present below:

- Risk level 1 = The injury is minor. First aid treatment is required.
- Risk level 2 = The injury is intermediate. Medical treatment is required.
- Risk level 3 = The injury is severe. Extensive treatment is required.

Note that risk activities were not ranked according to actual injuries. Each activity was ranked according to the highest level of injury that could have occurred from such an activity. Also note that this method of risk ranking is commonly used in occupational risk and hazard fields (Cockshott, 2005; Norsk Hydro ASA and DNV, 2002). Table 4.5 presents the level of risk for each activity as rated by the researcher.

Risk-taking behaviors	Description of highest level of injury	Risk level
Saw		
Not wearing safety glasses while cutting.	Wood or metal chips could fly and cause eye damage.	3
Not wearing a glove on the hand that holds the saw.	Participants could get cuts from the saw.	1
Not wearing a glove on the hand that holds the wood.	Participants could get cuts from the saw.	1
Not putting the safety guard back after using the saw.	Participants could get cuts from the saw.	1
Drill		
Not wearing safety glasses while drilling.	Wood or metal chips could fly and cause eye damage.	3
Not wearing safety glasses while driving a screw.	Wood or metal chips could fly and cause eye damage.	3
Not wearing a glove on the hand that holds the drill while drilling	Participants could get burns or blisters from the drill. Moving parts could create cuts on participants' hands.	1
Not wearing a glove on another hand while drilling.	Moving parts could create cuts or burns on participants' hands.	1
Not wearing a glove on the hand that holds the drill while driving a screw.	Participants could get burns or blisters from the drill. Moving parts could create cuts on participants' hands.	1
Not wearing a glove on another hand while driving a screw.	Moving parts could create cuts or burns on participants' hands.	1
Not using a clamp to hold the wood while drilling.	Work piece and moving parts could cause injury to participants.	1
Not using a clamp to hold the wood while driving a screw.	Work piece and moving parts could cause injury to participant	3
Using the drill power to tighten or loosen the chuck.	Moving part could fly and cause injury	2

Risk-taking behaviors	Description of highest level of injury	Risk level
Hammer		
Not wearing safety glasses while hammering.	Wood or metal chips could fly and cause eye damage.	1
Not wearing earplugs while hammering.	Extended noise could cause hearing damage.	1
Does not hold the hammer with a power grip while hammering.	Hammer could slip out of the grip and cause injury.	1
Holding nails by mouth.	Participants increase the chance of getting hurts from the nails.	1
Not holding the hammer at the base.	This increase the likelihood of participants missing a nail and cause injury to their hands.	1

Table 4.5: Risk-taking behavior assessment.

The total risk-taking behavior score for each participant was then divided by 27, which was the highest possible score, and was then multiplied by 10 to convert the data to a 10 point base system, which is easier for communication and interpretation. Note that this procedure can be carried out because the scale was equal. For example, the difference between 24 and 25 is equal to the difference between 3 and 4. This procedure was also done before any statistical tests were conducted.

4.3 Two-Factor and Two-Block Interactions Analysis

Two-factor and two-block design was used to test the overall effects of two independent variables and two blocks. The statistical structural model for this design is presented below. A summary of the ANOVA results with $\alpha = 0.05$ is presented in Table 4.6.

$$Y_{ijkl} = \mu + A_i + B_j + \alpha_k + \beta_l + AB_{ij} + A\alpha_{ik} + A\beta_{il} + B\alpha_{jk} + B\beta_{jl} + \alpha\beta_{kl} + AB\alpha_{ijk} + AB\beta_{ijl} + A\alpha\beta_{ikl} + B\alpha\beta_{jkl} + AB\alpha\beta_{ijkl} + \varepsilon$$

where i (order) =1-3, j (task) = 1-3, k (incentive) = 1-3, l (culture) = 1-3;

A = Order effect (block)

B = Task effect (block)

α = Incentive effect (factor)

β = Culture effect (factor)

AB = Interaction effect between order and task

$A\alpha$ = Interaction effect between order and incentive

$A\beta$ = Interaction effect between order and culture

$B\alpha$ = Interaction effect between task and incentive

$B\beta$ = Interaction effect between task and culture

$\alpha\beta$ = Interaction effect between incentive and culture

$AB\alpha$ = Interaction effect between order, task, and incentive

$AB\beta$ = Interaction effect between order, task, and culture

$A\alpha\beta$ = Interaction effect between order, incentive, and culture

$B\alpha\beta$ = Interaction effect between task, incentive, and culture

$AB\alpha\beta$ = Interaction effect between order, task, incentive, and culture

ε = Error effect of the variables;

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Order	2	8.2060	4.1030	0.57	0.5681
Task	2	4.4649	2.2324	0.31	0.7337
Incentive	2	4.2224	2.1111	0.30	0.7461
Culture	2	89.5036	44.7518	6.25	0.0043*
Order*Task	4	13.7029	3.4257	0.48	0.7511
Order*Incentive	4	16.5453	4.1363	0.58	0.6802
Order*Culture	4	34.1568	8.5392	1.19	0.3282
Task*Incentive	4	10.9429	2.7357	0.38	0.8200
Task*Culture	4	9.1672	2.2918	0.32	0.8628
Incentive*Culture	4	11.1526	2.7881	0.39	0.8148
Order*Task*Incentive	7	58.0453	8.2922	1.16	0.3471
Order*Task*Culture	7	52.8798	7.5543	1.06	0.4088
Order*Incentive*Culture	7	75.4637	10.7805	1.51	0.1922
Task*Incentive*Culture	7	65.8305	9.4044	1.31	0.2682
Order*Task*Incentive*Culture	5	9.0540	1.8108	0.25	0.9359
Error	41	293.3812	7.1556		
Corrected Total	107	7444.1871			

*p<0.05

Table 4.6: ANOVA summary results for risk-taking behavior.

The testing hypothesis is:

H_0: "effect" = 0 versus. H_1: "effect" $\neq$ 0

Reject H_0 if $F=(MS(\text{"effect"})/MSE) > F_{df1,df2,\alpha}$

where *df1*=("effect"), *df2*=("error"), and $\alpha = 0.05$

Results, presented in Table 4.7, from four-way interaction, three-way interaction, and two-way interaction tests show that there was no effect from these interactions. The results suggested that the main effects, including reward systems, culture, orders, and tasks, could be tested individually. The tests indicated that there was no effect from reward systems, orders, and tasks, while there was an effect from culture. Further tests for reward systems and cultures presented later in this chapter were conducted and confirmed the same finding. The results indicated that the order of the tasks, whether it was the first, second, or third task that the participants performed, did not affect the participants' risk-taking behavior. The results also indicated that the tasks, whether it was task A, task B, or task C, did not affect the participants' risk-taking behavior.

Effect	**MS("effect")/ MSE**	$\mathbf{F_{df1,df2,\alpha}}$	**Decision**
Order*Task*Incentive*Culture	0.2531	2.4434	Accept H_0
Order*Task*Incentive	1.1588	2.2429	Accept H_0
Order*Task*Culture	1.0557	2.2429	Accept H_0
Order*Incentive*Culture	1.5066	2.2429	Accept H_0
Task*Incentive*Culture	1.3143	2.2429	Accept H_0
Order*Task	0.4951	2.6000	Accept H_0
Order*Incentive	0.5781	2.6000	Accept H_0
Order*Culture	1.1934	2.6000	Accept H_0
Task*Incentive	0.3823	2.6000	Accept H_0
Task*Culture	0.3203	2.6000	Accept H_0
Incentive*Culture	0.3896	2.6000	Accept H_0
Order	0.5734	3.2257	Accept H_0
Task	0.3120	3.2257	Accept H_0
Incentive	0.2950	3.2257	Accept H_0
Culture	6.2541	3.2257	Reject H_0

Table 4.7: Effect testing summary table for risk-taking behavior.

4.4 Risk-Taking Behavior Results at a Glance

The summary of the risk-taking behavior results is shown in Table 4.8. The results show that participants tended to increase their risk-taking behavior as time goes by (order 3's mean was higher than order 2's mean and order 2's mean was higher than order 1's mean). However, the order effect test mentioned earlier that these differences were not significant. Task A's mean was higher than Task B's, and Task B's mean was higher than Task C's. The task effect test presented earlier also shows that the differences were not significant.

Participants	Reward systems	n	Mean	Standard Deviation
All	Reward	36	4.7886	2.6157
	Penalty	36	4.7602	2.7771
	None	36	4.8723	2.5887
American	All	36	5.3370	2.5244
Asian		36	3.3366	2.2817
Latin American		36	5.7476	2.5021
American	Reward	12	5.1987	2.5665
Asian		12	3.3237	2.3029
Latin American		12	5.8434	2.4780
American	Penalty	12	5.3337	2.6704
Asian		12	3.4240	2.6477
Latin American		12	5.5228	2.7307
American	None	12	5.4785	2.5527
Asian		12	3.2620	2.0584
Latin American		12	5.8764	2.4980
Participants	**Blocks**	**n**	**Mean**	**Standard Deviation**
All	Order 1	36	4.5515	2.7706
	Order 2	36	4.7485	2.6636
	Order 3	36	5.1210	2.5139
All	Task A	36	4.9121	2.5672
	Task B	36	4.8759	2.6474
	Task C	36	4.6331	2.7597

Table 4.8: Risk-taking behavior means.

4.5 Internal Consistency of the Questionnaires

The internal consistency of each questionnaire was tested to ensure that the questionnaire items were statistically correlated. High internal consistency of a questionnaire indicates that the items on the questionnaire are interrelated and provide the same or similar results (Crano & Brewer, 2002). Researchers can be assured that items actually measure the same underlying construct (Crano & Brewer, 2002). In this study, Cronbach's Alpha was computed for each questionnaire. Items that had low correlation with the overall of the questionnaire were removed. The final Cronbach's Alphas were computed which excluded removed items. The initial and final Cronbach's Alphas, along with the removed items are presented in Table 4.9. More details of this process are presented in Appendix Q.

Questionnaire	Number of Items	Initial Cronbach's Alpha	Removed Items	Number of Items	Final Cronbach's Alpha
General risk perception	22	0.8872	1,8,11,15,19	17	0.8968
Construction risk perception	15	0.9387	None	15	0.9387
Construction risk-taking behavior	15	0.9599	None	15	0.9599
Internal locus of control	8	0.6518	6,8	6	0.7314
External locus of control	8	0.3537	2,5,16	5	0.5777
Self-efficacy	10	0.7489	7,9	8	0.7829

Table 4.9: Initial and final Cronbach's Alphas for the questionnaires.

4.6 Other Results at a Glance

Besides risk-taking behavior observed during the experiment, other results obtained are presented in Table 4.10 and Table 4.11. The results are used in the discussion presented in the following chapter.

Results	**American**	**Asian**	**Latin American**
General Risk Perception (1-5)	2.9118	3.2745	3.2059
Construction Risk Perception (1-5)	3.4722	3.8556	3.9889
Construction Risk-Taking (1-5)	2.7889	2.5278	3.0111
Internal Locus of Control (1-6)	4.3472	4.5278	4.6944
External Locus of Control (1-6)	3.3833	3.4333	3.4333
Self-Efficacy (1-6)	4.0104	4.5729	4.4271
Post-Experiment Risk Perception (1-5)	2.1275	2.7010	2.3873

Table 4.10: Means across cultures.

Results	Rewards	Penalty	None
Rush (1-6)	4.3333	4.4444	2.9722
Pressure (1-6)	4.4167	4.9444	3.1944
Safety (1-6)	4.4444	4.5833	4.5
Motivation (1-6)	4.6667	4.25	3.8889
Quality (100)	76.2778	84.1111	83.8333
Time (minutes)	25.5567	24.2514	26.6339

Table 4.11 Means across reward systems

4.7 Hypotheses Testing

The test carried out earlier in section 4.3 indicated no interaction between treatments (incentive and culture) and blocks (orders and tasks). As presented earlier, the analysis of the treatment effects (reward systems and culture) could be performed. Note that α used in this study was 0.05, unless stated otherwise.

A two-sample paired t-test was used for testing hypothesis 1-3 with the testing statistics shown below:

H_0: $\mu_1 = \mu_2$ versus H_1: $\mu_1 > \mu_2$

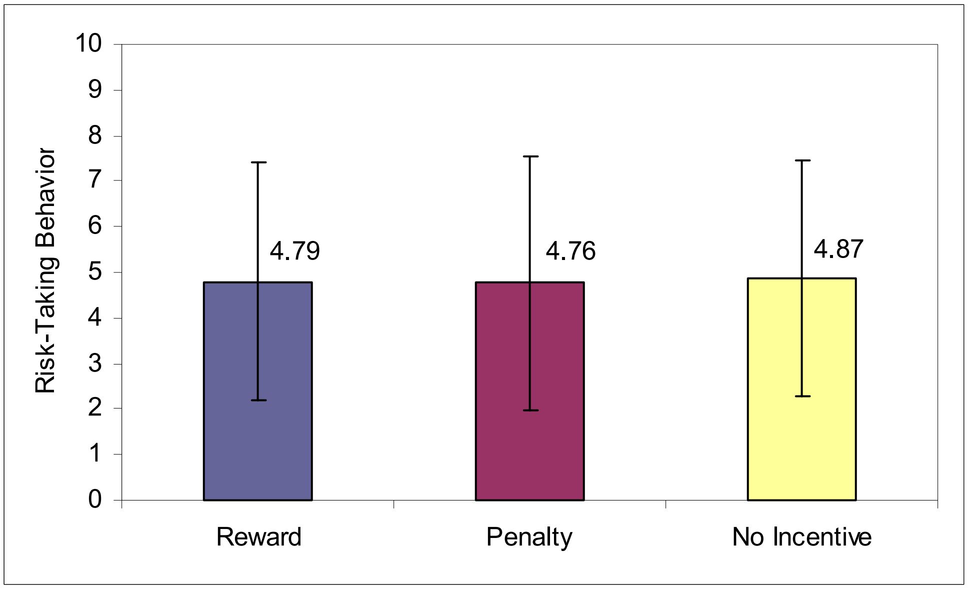
$$t_o = \frac{\overline{y_1} - \overline{y_2}}{S_D / \sqrt{n}}$$

The rejection rule is to reject H_0 if $t_o > t_{n-1,\alpha}$ where,

$$S_D = \sqrt{\frac{1}{n-1}\left[\sum_{i=1}^{n} d_i^2 - \frac{1}{n}\left(\sum_{i=1}^{n} d_i\right)^2\right]}$$

$$d = y_{1i} - y_{2i}$$

Risk-taking behavior means used for hypothesis 1-3 testing for each incentive scheme are presented in Figure 4.5.



*p>0.1, not significant

Figure 4.5 Overall risk-taking behavior means across all incentive schemes.

Hypothesis 1: When exposed to rewards, construction workers' risk-taking behavior will be higher than when there is none.

H_0: Construction worker's risk-taking behaviors when there are rewards = Construction worker's risk taking behavior when there is none.

H_1: Construction worker's risk-taking behaviors when there are rewards > Construction worker's risk taking behavior when there is none.

1: Rewards; 2: None;

$t_o = -0.4838$

$t_{35,0.05} = 2.0301$

$t_o < t_{35,0.05}$ therefore the result suggested accepting H_0. The result from additional testing using H_1: $\mu_2 > \mu_1$ suggested accepting H_0 as well. It can be concluded that no difference in risk-taking behavior was found between rewards and none.

Hypothesis 2: When exposed to a penalty, construction workers' risk-taking behavior will be higher than when there is none.

H_0: Construction worker's risk-taking behaviors when there is a penalty = Construction worker's risk taking behavior when there is none.

H_1: Construction worker's risk-taking behaviors when there is a penalty > Construction worker's risk taking behavior when there is none

1: Penalty; 2: None;

$t_o = -0.6460$

$t_{35,0.05} = 2.0301$

$t_o < t_{35,0.05}$ therefore the result suggested accepting H_0. The result from additional testing using H_1: $\mu_2 > \mu_1$ suggested accepting H_0 as well. It can be concluded that no difference in risk-taking behavior was found between penalty and none.

Hypothesis 3: When exposed to a penalty, construction workers' risk-taking behavior will be higher than when rewards are offered.

H_0: Construction worker's risk-taking behavior when there is a penalty = Construction worker's risk taking behavior when there are rewards

H_1: Construction worker's risk-taking behaviors when there is a penalty > Construction worker's risk taking behavior when there are rewards

1: Penalty; 2: Rewards;

$t_o = -0.1225$

$t_{35,0.05} = 2.0301$

$t_o < t_{35,0.05}$ therefore the result suggested accepting H_0. The result from additional testing using H_1: $\mu_2 > \mu_1$ suggested accepting H_0 as well. It can be concluded that no difference in risk-taking behavior was found between penalty and rewards.

Additional tests were conducted comparing risk-taking behavior across reward systems within each culture. A two-sample paired t-test was also used for these tests, with:

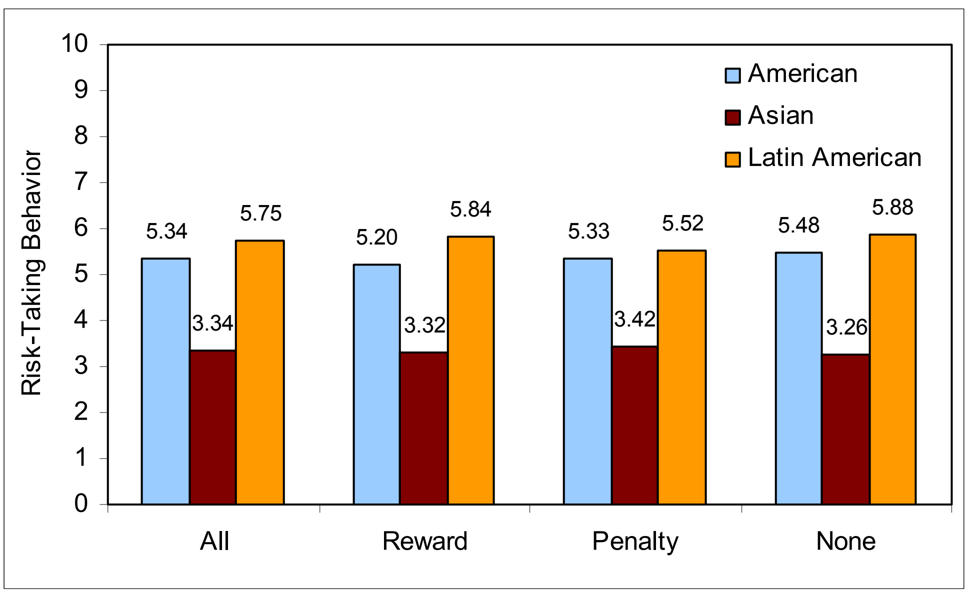
$$H_0: \mu_1 = \mu_2 \text{ versus } H_1: \mu_1 > \mu_2$$

A summary of the hypothesis testing results is shown in Table 4.12.

Culture	Alternative Hypotheses (H_1: $\mu_1 > \mu_2$)	t_o	$t_{11,0.05}$	Decision
American	None > Rewards	0.6634	2.2010	Accept H_0
	None > Penalty	1.1986	2.2010	Accept H_0
	Penalty > Rewards	0.3448	2.2010	Accept H_0
Asian	Rewards > None	0.2444	2.2010	Accept H_0
	Penalty > None	0.1620	2.2010	Accept H_0
	Penalty > Rewards	0.1003	2.2010	Accept H_0
Latin American	None > Rewards	0.1685	2.2010	Accept H_0
	None > Penalty	1.8479	2.2010	Accept H_0
	Rewards > Penalty	1.1190	2.2010	Accept H_0

Table 4.12: Summary of hypothesis testing results across reward systems within each culture.

Figure 4.6 shows the means across all cultural groups when different reward systems were offered.



* $p < 0.05$ for overall culture comparison

Figure 4.6: Risk-taking behavior means across all cultural groups.

For hypothesis 4-6, a two-sample Welch t-test was used with the testing statistics show below:

H$_0$: $\mu_1 = \mu_2$ versus H$_1$: $\mu_1 > \mu_2$

$$W_o = \frac{\overline{y_1} - \overline{y_2}}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

The rejection rule was to reject H$_0$ if $W_o > t_{dfs,\alpha}$ where,

$$df_s = \frac{\left(\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}\right)^2}{\frac{\left(\frac{S_1^2}{n_1}\right)^2}{n_1 - 1} + \frac{\left(\frac{S_2^2}{n_2}\right)^2}{n_2 - 1}}$$

Hypothesis 4: When exposed to rewards, the extent of risk-taking behaviors of construction workers who are from different cultures will be different.

Hypothesis 4A: When exposed to rewards, the risk-taking behavior of construction workers from Asia will be higher than the risk-taking behavior of construction workers from the U.S.

H$_0$: When exposed to rewards, Asian construction worker's risk-taking behaviors = American construction worker's risk taking behavior

H$_1$: When exposed to rewards, Asian construction worker's risk-taking behaviors > American construction worker's risk taking behavior

1: Asian; 2: American;

W_o = -1.8836

$t_{21,0.05}$ = 2.0796

$W_o < t_{21,0.05}$ therefore the result suggested accepting H_0. The result from additional testing using H_1: $\mu_2 > \mu_1$ suggested accepting H_0 ($p = 0.0735$) as well. It can be concluded that no difference in risk-taking behavior was found between Asians and Americans when rewards were offered.

Hypothesis 4B: When exposed to rewards, the risk-taking behavior of construction workers from Latin America will be higher than the risk-taking behavior of construction workers from the U.S.

H_0: When exposed to rewards, Latin American construction worker's risk-taking behavior = American construction worker's risk taking behavior

H_1: When exposed to rewards, Latin American construction worker's risk-taking behavior > American construction worker's risk taking behavior

1: Latin American; 2: American;

$W_o = 0.6261$

$t_{21,0.05} = 2.0796$

$W_o < t_{21,0.05}$ therefore the result suggested accepting H_0. The result from additional testing using H_1: $\mu_2 > \mu_1$ suggested accepting H_0 ($p=0.5381$) as well. It can be concluded that no difference in risk-taking behavior was found between Latin Americans and Americans when rewards were offered.

Hypothesis 4C: When exposed to rewards, the risk-taking behavior of construction workers from Latin America will be higher than the risk-taking behavior of construction workers from Asia.

H_0: When exposed to rewards, Latin American construction worker's risk-taking behavior = Asian construction worker's risk taking behavior

H_1: When exposed to rewards, Latin American construction worker's risk-taking behavior > Asian construction worker's risk taking behavior

1: Latin American; 2: Asian;

$W_o = 2.5802$

$t_{21,0.05} = 2.0796$

$W_o > t_{21,0.05}$ therefore the result suggested rejecting H_0. Therefore, Latin Americans had higher (p=0.0175) risk-taking behaviors than Asians when rewards were offered.

Hypothesis 5: When exposed to a penalty, the extent of risk-taking behavior of construction workers from different cultures will be different.

Hypothesis 5A: When exposed to a penalty, the risk-taking behavior of construction workers from Asia will be higher than the risk-taking behavior of construction workers from the U.S.

H_0: When exposed to a penalty, Asian construction worker's risk-taking behaviors = American construction worker's risk taking behavior

H_1: When exposed to a penalty, Asian construction worker's risk-taking behaviors > American construction worker's risk taking behavior

1: Asian; 2: American;

$W_o = -1.7592$

$t_{21,0.05} = 2.0796$

$W_o < t_{21,0.05}$ therefore the result suggested accepting H_0. The result from additional testing using H_1: $\mu_2 > \mu_1$ suggested accepting H_0. It can be concluded that no difference (p=0.0931) in risk-taking behavior was found between Asians and Americans when a penalty was in place.

Hypothesis 5B: When exposed to a penalty, the risk-taking behavior of construction workers from Latin America will be higher than the risk-taking behavior of construction workers from the U.S.

H_0: When exposed to a penalty, Latin American construction worker's risk-taking behavior = American construction worker's risk taking behavior

H_1: When exposed to a penalty, Latin American construction worker's risk-taking behavior > American construction worker's risk taking behavior

1: Latin American; 2: American;

$W_o = 0.1715$

$t_{21,0.05} = 2.0796$

$W_o < t_{21,0.05}$ therefore the result suggested accepting H_0. The result from additional testing using H_1: $\mu_2 > \mu_1$ suggested accepting H_0 (p=0.8655). It can be concluded that no difference in risk-taking behavior was found between Latin Americans and Americans when a penalty was in place.

Hypothesis 5C: When exposed to penalty, the risk-taking behavior of construction workers from Latin America will be higher than the risk-taking behavior of construction workers from Asia.

H_0: When exposed to a penalty, Latin American construction worker's risk-taking behavior = Asian construction worker's risk taking behavior

H_1: When exposed to a penalty, Latin American construction worker's risk-taking behavior > Asian construction worker's risk taking behavior

1: Latin American; 2: Asian;

$W_o = 1.9115$

$t_{21,0.05} = 2.0796$

$W_o < t_{21,0.05}$ therefore the result suggested accepting H_0. The result from additional testing using H_1: $\mu_2 > \mu_1$ suggested accepting H_0 (p=0.0697). It can be concluded that no difference in risk-taking behavior was found between Latin Americans and Asians when a penalty was in place.

Hypothesis 6: When there is no reward or penalty, the extent of risk-taking behaviors of construction workers from different cultures will be different.

Hypothesis 6A: When there is no reward or penalty, the risk-taking behavior of construction workers from Asia will be higher than the risk-taking behavior of construction workers from the U.S.

H_0: When there is no reward or penalty, Asian construction worker's risk-taking behavior = American construction worker's risk taking behavior

H_1: When there is no reward or penalty, Asian construction worker's risk-taking behavior > American construction worker's risk taking behavior

1: Asian; 2: American;

$W_o = -2.3416$

$t_{21,0.05} = 2.0796$

$W_o < t_{21,0.05}$ therefore the result suggested accepting H_0. Additional testing using H_1: $\mu_2 > \mu_1$, found $W_o = 2.3416 > t_{21,0.05}$, thus H_0 was rejected (p=0.0292). Therefore, with no reward or penalty, Americans had a higher risk-taking behavior than Asians.

Hypothesis 6B: When there is no reward or penalty, the risk-taking behavior of construction workers from Latin America will be higher than the risk-taking behavior of construction workers from the U.S.

H_0: When there is no reward or penalty, Latin American construction worker's risk-taking behavior = American construction worker's risk taking behavior

H_1: When there is no reward or penalty, Latin American construction worker's risk-taking behavior > American construction worker's risk taking behavior

1: Latin American; 2: American;

$W_o = 0.3859$

$t_{21,0.05} = 2.0796$

$W_o < t_{21,0.05}$ therefore the result suggested accepting H_0. The result from additional testing using H_1: $\mu_2 > \mu_1$ suggested accepting H_0 (p=0.7035). It can be concluded that no difference in risk-taking behavior was found between Latin Americans and Americans when there was no reward or penalty.

Hypothesis 6C: When there is no reward or penalty, the risk-taking behavior of construction workers from Latin America will be higher than the risk-taking behavior of construction workers from Asia.

H_o: When there is no reward or penalty, Latin American construction worker's risk-taking behavior = Asian construction worker's risk taking behavior

H_1: When there is no reward or penalty, Latin American construction worker's risk-taking behavior > Asian construction worker's risk taking behavior

1: Latin American; 2: Asian;

$W_o = 2.7981$

$t_{21,0.05} = 2.0796$

$W_o > t_{21,0.05}$ therefore the result suggested rejecting H_0 (p=0.0108). Therefore, when there was no reward or penalty, Latin Americans had a higher risk-taking behavior than Asians.

Hypothesis 7: The quality of a task decreases when the risk-taking behavior increases.

Correlation analysis was conducted and found a correlation coefficient of, r = 0.0849. Nonlinear correlation analysis was conducted as well and found no relationship between these two variables. It can be concluded that there was no relationship between quality and risk-taking behavior. Correlation analysis between risk-taking behavior and incentive preference found r = 0.0265, between risk-taking behavior and motivation found r = 0.1680, between quality and incentive preference found r = 0.0232, and between quality and motivation to work found r = 0.1248. It can be concluded that there were no relationships between these variables. Figure 4.7 shows a plot between the quality of the task and the risk-taking behavior.

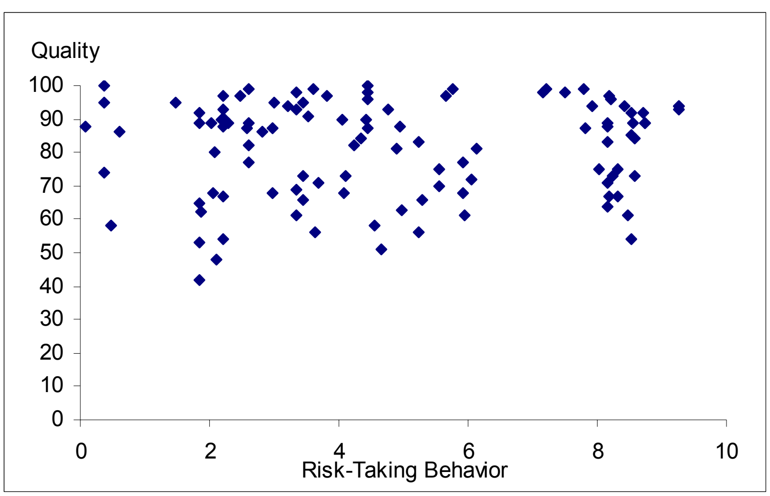


Figure 4.7: Plot shows low correlation between quality and risk-taking behavior.

Hypothesis 8: The time required to finish a task decreases when the risk-taking behavior increases.

Correlation analysis was conducted and found $r = 0.0009$. Nonlinear correlation analysis was conducted as well and found no relationship between these two variables. It can be concluded that there was no relationship between the time required to finish a task and the risk-taking behavior. Figure 4.8 shows a plot between the time taken to complete the task and the risk-taking behavior. Additional correlation analysis was conducted and found $r = -0.1482$ between the time taken to complete the task and the incentive preference, and $r = -0.1640$ between the time taken to complete the task and the motivation. It can be concluded that there was no relationship between these variables.

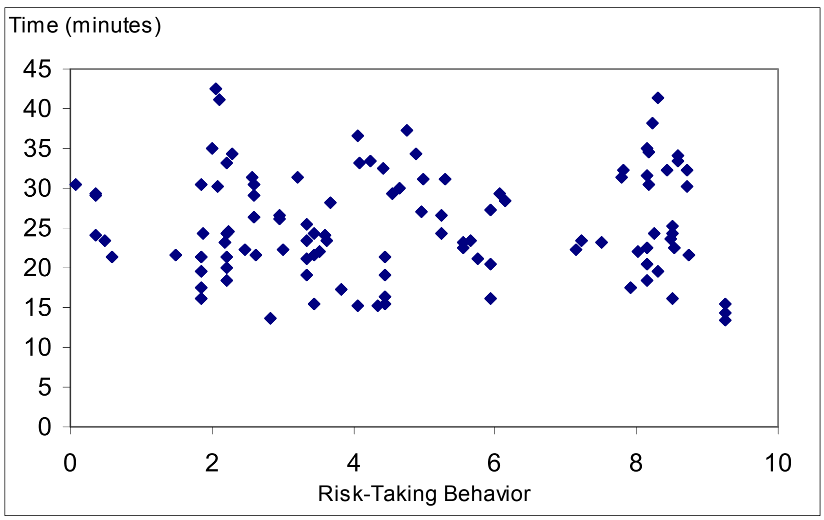


Figure 4.8: Plot shows low correlation between time and risk-taking behavior.

Hypothesis 9: Construction workers with a lower construction risk perception have a higher risk-taking behavior than construction workers with a higher construction risk perception, when exposed to different reward systems.

As presented earlier, Cronbach's alpha for construction risk perception = 0.9387. Correlation analysis was conducted and found $r = -0.1070$. Nonlinear correlation analysis was conducted as well and found no relationship between these two variables. Figure 4.9 shows a plot between the construction risk perception and the risk-taking behavior. From this figure, it can be observed that there was no relationship between construction risk perception and risk-taking behavior.

Correlation analysis between construction risk perception and construction risk-taking behavior was conducted at the item level and found *r* = -0.0840, thus it can be concluded that there was no relationship at the item level between these two variables. Correlation between construction risk perception and construction risk-taking behavior was conducted at the overall level and found *r* = 0.0016, thus it can be concluded that there was no relationship at the overall level between construction risk perception and risk-taking behavior.

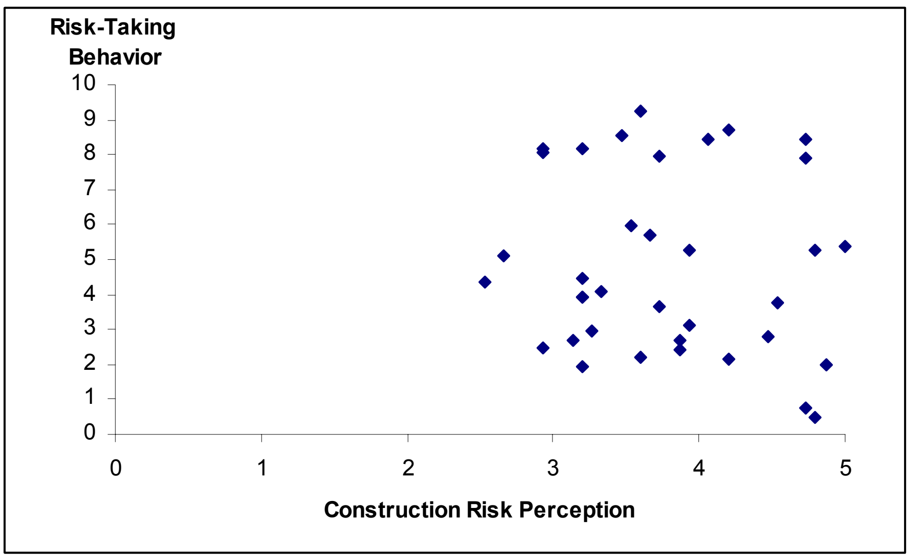


Figure 4.9: Plot shows low correlation between construction risk perception and risk-taking behavior.

Hypothesis 10: Construction workers with an external locus of control have higher risk-taking behavior than construction workers with an internal locus of control, when exposed to different reward systems.

Correlation analysis was conducted between internal locus of control and risk-taking behavior and found *r* = -0.0651. Nonlinear correlation analysis was conducted as well and found no relationship between these two variables. It can be concluded that there was no relationship between internal locus of control and the risk-taking behavior. Note that Cronbach's alpha for internal locus of control = 0.7314. Figure 4.10 shows a plot between the internal locus of control and the risk-taking behavior. Additional correlation analysis was conducted between internal locus of control and the risk-taking behavior when rewards, a penalty, or none were/was offered and found *r* = -0.0231, -0.1082, and -0.0548, respectively. It can be concluded that no relationship existed among these variables.

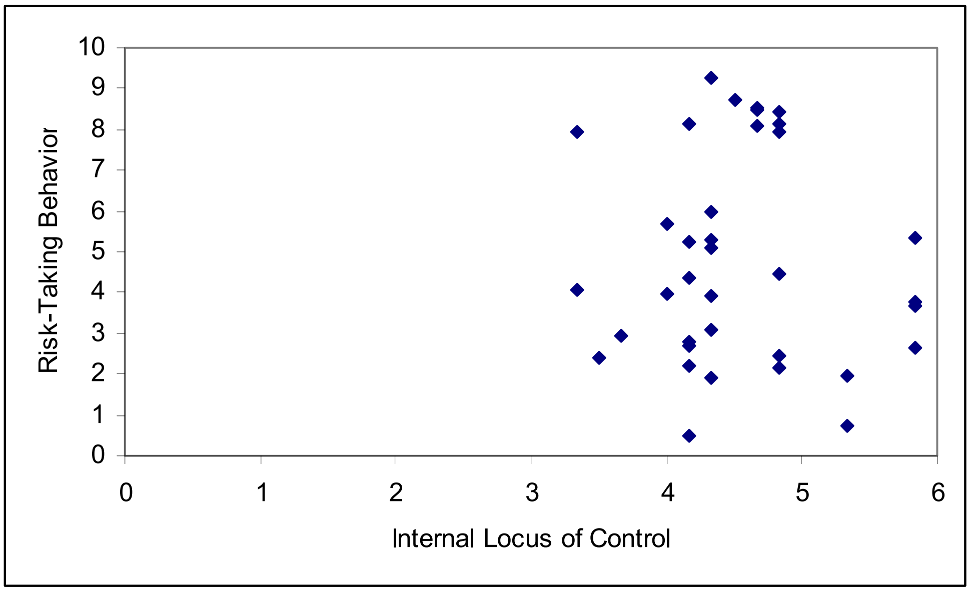


Figure 4.10: Plot shows low correlation between internal locus of control and risk-taking behavior.

Correlation analysis was conducted between external locus of control and risk-taking behavior and found *r* = -0.1098. Nonlinear correlation analysis was conducted as well and found no relationship between these two variables. It can be concluded that there was no relationship between external locus of control and the risk-taking behavior. Note that Cronbach's alpha for external locus of control = 0.5777. Figure 4.11 shows a plot between the external locus of control and the risk-taking behavior. Additional correlation analysis was conducted between the external locus of control and the risk-taking behavior when rewards, a penalty, or none were/was offered and found *r* = -0.0530, 0.0985, and -0.1684, respectively. It can be concluded that no relationship existed among these variables.

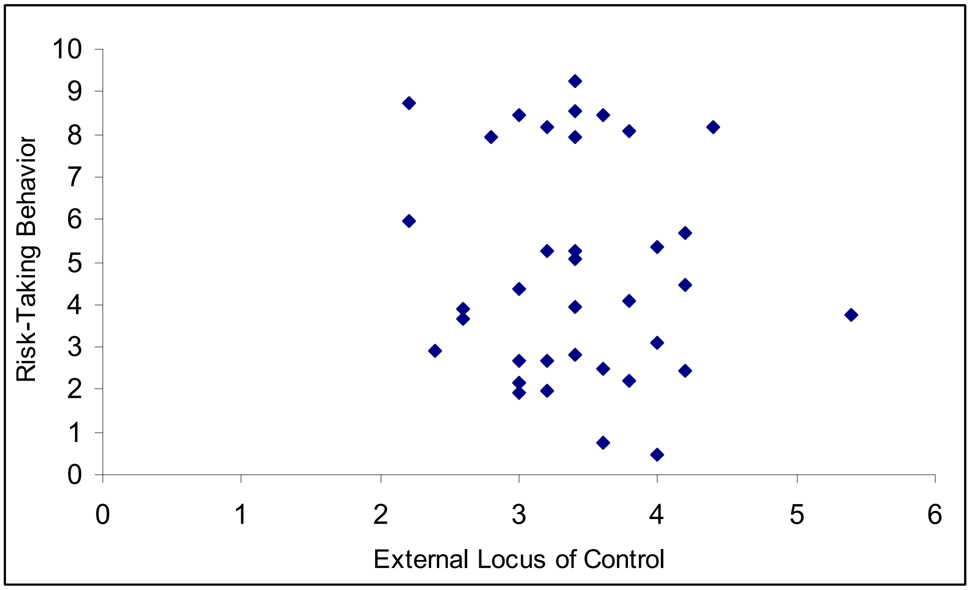


Figure 4.11: Plot shows low correlation between external locus of control and risk-taking behavior

Hypothesis 11: Construction workers with high self-efficacy have lower risk-taking behavior than construction workers with low self-efficacy, when exposed to different reward systems.

Correlation analysis was conducted between self-efficacy (with Cronbach's alpha = 0.7830) and risk-taking behavior and found r = -0.0574. Nonlinear correlation analysis was conducted as well and found no relationship between these two variables. Additional correlation analysis was conducted between self-efficacy and risk-taking behavior when rewards, a penalty, or none were/was offered and found r = -0.0605, -0.0634, and -0.0423, respectively. Figure 4.12 shows low correlation between self-efficacy and risk-taking behavior. It can be concluded that no relationship existed between self-efficacy and risk-taking behavior.

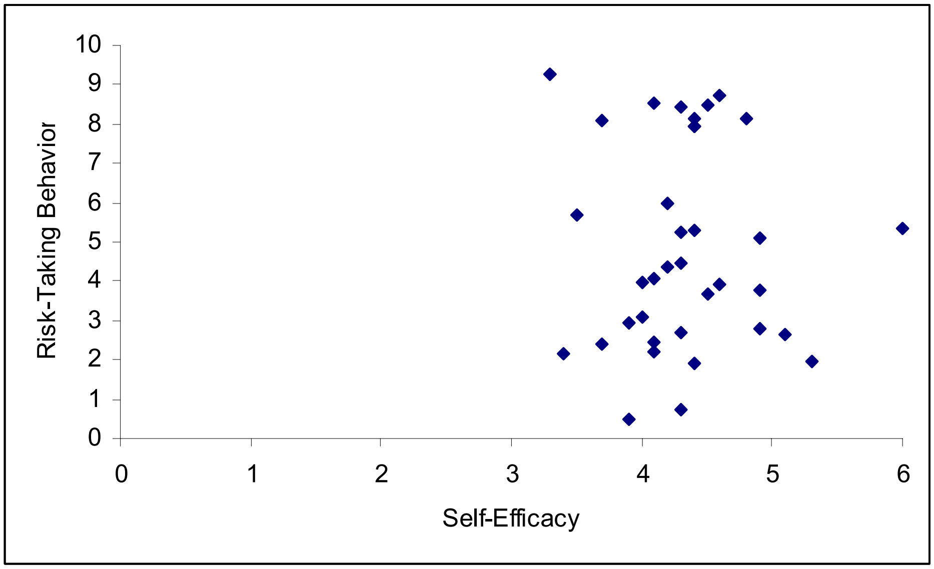


Figure 4.12: Plot shows low correlation between self-efficacy and risk-taking behavior.

Hypothesis 12: Construction workers' general risk perception differs from their construction risk perception.

H_0: Construction workers' general risk perception = construction workers' construction risk perception.

H_1: Construction workers' general risk perception ≠ construction workers' construction risk perception.

1: General risk perception; 2: Construction risk perception;

Two-sample paired t-test was used. H_0: $\mu_1 = \mu_2$ versus H_1: $\mu_1 \neq \mu_2$. The rejection rule is to reject H_0 if $t_o < -t_{n-1,/\alpha/2}$ or $t_o > t_{n-1,/\alpha/2}$.

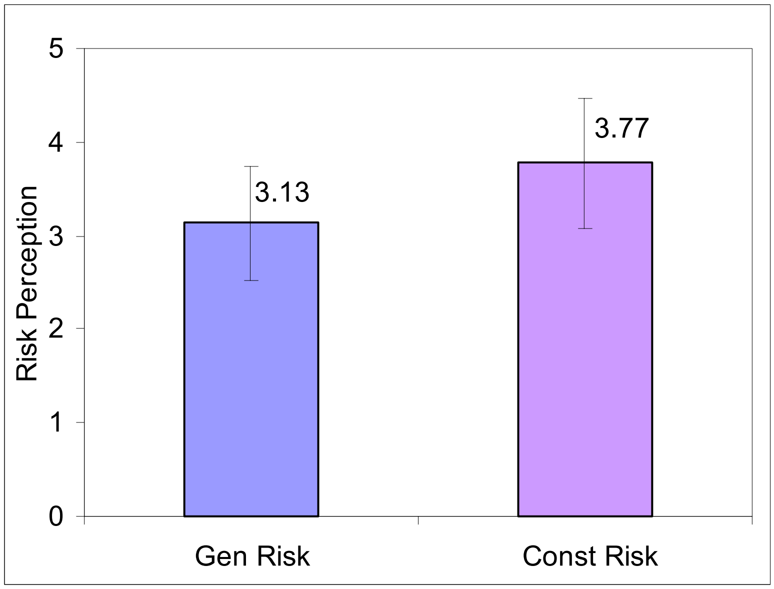
$t_o = -5.73042$

$-t_{35,0.025} = -2.3420$

$t_{35,0.025} = 2.34120$

$t_o < -t_{35,0.025}$, therefore the result suggested rejecting H_0 which shows that the general risk perception differed from the construction risk perception. Further testing with H_0: $\mu_1 = \mu_2$ versus H_1: $\mu_1 < \mu_2$ found $-t_{35,0.05} = -2.0301$, $t_o < -t_{35,0.05}$. The test rejected H_0 and thus it can be concluded that construction risk perception was higher than general risk perception.

Figure 4.13 shows means and standard deviations of two variables. Correlation analysis was also conducted and found $r = 0.4669$.



*p<0.05

Figure 4.13: Means and standard deviations of general risk perception and construction risk perception.

4.8 Additional Tests

As show in Table 4.8, the risk-taking behavior mean at the overall level (all reward systems) for Latin Americans was higher than Americans and Asians. Additional tests were conducted to test whether these differences were significant. A two-sample Welch t-test was used with H_0: $\mu_1 = \mu_2$ versus H_1: $\mu_1 > \mu_2$, and the rejection rule was to reject H_0 if $W_o > t_{dfs,\alpha}$.

4.8.1 Additional Hypotheses Testing Across Cultures

Hypothesis AT 1: Americans have a higher risk-taking behavior than Asians

H_0: American construction worker's risk-taking behavior = Asian construction worker's risk taking behavior

H_1: American construction worker's risk-taking behavior > Asian construction worker's risk taking behavior

1: American; 2: Asian;

$W_o = 3.5272$

$t_{69,0.05} = 1.9950$

$W_o > t_{69,0.05}$ and H_0 was rejected (p-value = 0.0008) which indicated that Americans had a higher risk-taking behavior than Asians.

Hypothesis AT2: Latin Americans have a higher risk-taking behavior than Americans

H_0: Latin American construction worker's risk-taking behavior = American construction worker's risk taking behavior

H_1: Latin American construction worker's risk-taking behavior > American construction worker's risk taking behavior

1: Latin American; 2: American;

$W_o = 0.6931$

$t_{69,0.05} = 1.9950$

$W_o < t_{69,0.05}$ and H_0 was accepted which showed that there was no significant difference (p=0.4906) in risk-taking behavior between Latin Americans and Americans.

Hypothesis AT3: Latin Americans have a higher risk-taking behavior than Asians

H_0: Latin American construction worker's risk-taking behavior = Asian construction worker's risk taking behavior

H_1: Latin American construction worker's risk-taking behavior > Asian construction worker's risk taking behavior

1: Latin American; 2: Asian;

$W_o = 4.2720$

$t_{69,0.05} = 1.9950$

$W_o > t_{69,0.05}$ and H_0 was rejected (p <0.0001) which indicated that Latin Americans had higher risk-taking behavior than Asians.

4.8.2 Additional Hypotheses Testing Across Reward systems

After participants completed the experiment, the participants were asked to rate their feelings on whether (1) they were in a rush, (2) they felt pressured to work fast during the experiment, (3) they performed the task safely, and (4) they were motivated during the tasks.

Hypothesis tests were conducted to compare these results across reward systems. A two-sample paired t-test was used for each of the hypothesis testing in this section.

The testing hypothesis was:

H_0: $\mu_1 = \mu_2$ versus H_1: $\mu_1 > \mu_2$

$$t_o = \frac{\overline{y_1} - \overline{y_2}}{S_D / \sqrt{n}}$$

The rejection rule was to reject H_0 if $t_o > t_{n-1,\alpha}$ where,

$$S_D = \sqrt{\frac{1}{n-1}\left[\sum_{i=1}^{n} d_i^2 - \frac{1}{n}\left(\sum_{i=1}^{n} d_i\right)^2\right]}$$

$$d = y_{1i} - y_{2i}$$

A summary of the hypothesis testing results is shown in Table 4.13.

Alternative Hypotheses (H_1: $\mu_1 > \mu_2$)	t_o	$t_{35,0.05}$	**Decision**	**p-value**
Penalty quality > Reward quality	2.5001	2.0301	Reject H_0	0.0173*
None quality > Reward quality	3.0427	2.0301	Reject H_0	0.0044*
Penalty quality > None quality	0.1087	2.0301	Accept H_0	0.9141
Reward time > Penalty time	1.2274	2.0301	Accept H_0	0.2279
None time > Reward time	0.8347	2.0301	Accept H_0	0.4096
None time > Penalty time	2.0383	2.0301	Reject H_0	0.0492*
Penalty rush > Reward rush	0.5199	2.0301	Accept H_0	0.6065
Reward rush > None rush	4.6425	2.0301	Reject H_0	<0.0001*
Penalty rush > None rush	4.7125	2.0301	Reject H_0	<0.0001*
Penalty pressure > Reward pressure	2.2892	2.0301	Reject H_0	0.0283*
Reward pressure > None pressure	4.2095	2.0301	Reject H_0	0.0002*
Penalty pressure > None pressure	6.6694	2.0301	Reject H_0	<0.0001*
Penalty safety > Reward safety	0.8956	2.0301	Accept H_0	0.3767
None safety > Reward safety	0.4422	2.0301	Accept H_0	0.6611
Penalty safety > None safety	0.5719	2.0301	Accept H_0	0.5711
Reward motivation > Penalty motivation	2.0364	2.0301	Reject H_0	0.0494*
Reward motivation > None motivation	2.9732	2.0301	Reject H_0	0.0054*
Penalty motivation > None motivation	1.2928	2.0301	Accept H_0	0.2046

*p<0.05

Table 4.13 Summary of hypothesis testing results across reward systems

The quality of a task with a penalty and no reward or penalty schemes were statistically higher than the reward scheme. Participants took statistically longer to finish a task with no reward or penalty than a task with a penalty. Participants felt that they were in a rush during the reward and penalty schemes statistically more than during no reward or penalty scheme. Also, participants felt the most pressure to work fast during the penalty scheme, followed by the reward scheme. They felt the least pressure when there was no reward or penalty. Their motivation to perform the tasks was statistically the highest during the reward scheme, while no difference was found between penalty and no reward or penalty schemes. Participants were careful in terms of their own safety at the same level across all reward system schemes. Results from statistics tests showed that participants performed better in terms of time and quality when there was a penalty, however participants did not perform better when rewards were offered. Figure 4.14, Figure 4.15, Figure 4.16 show the means of the results discussed here.

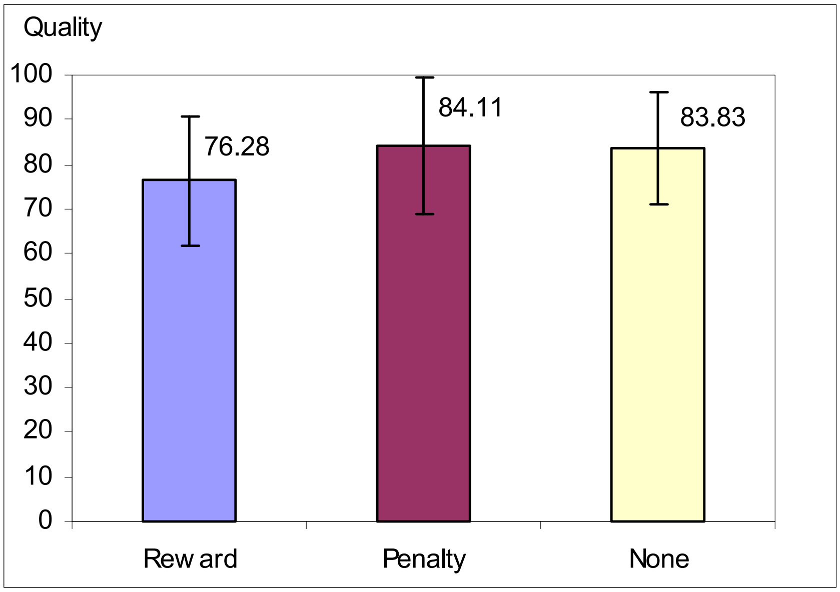


Figure 4.14: Quality of the tasks across reward systems.

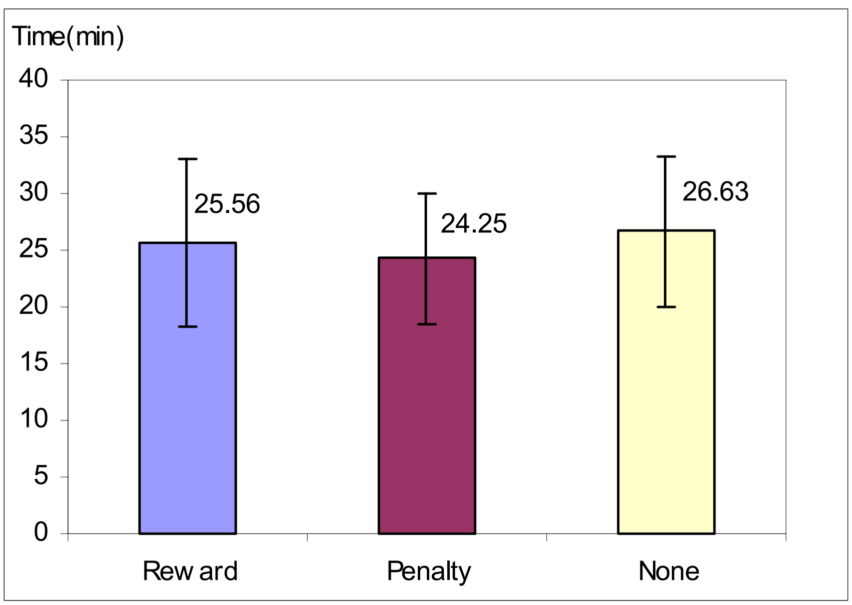


Figure 4.15: Time (minutes) used to finish the tasks across reward systems.

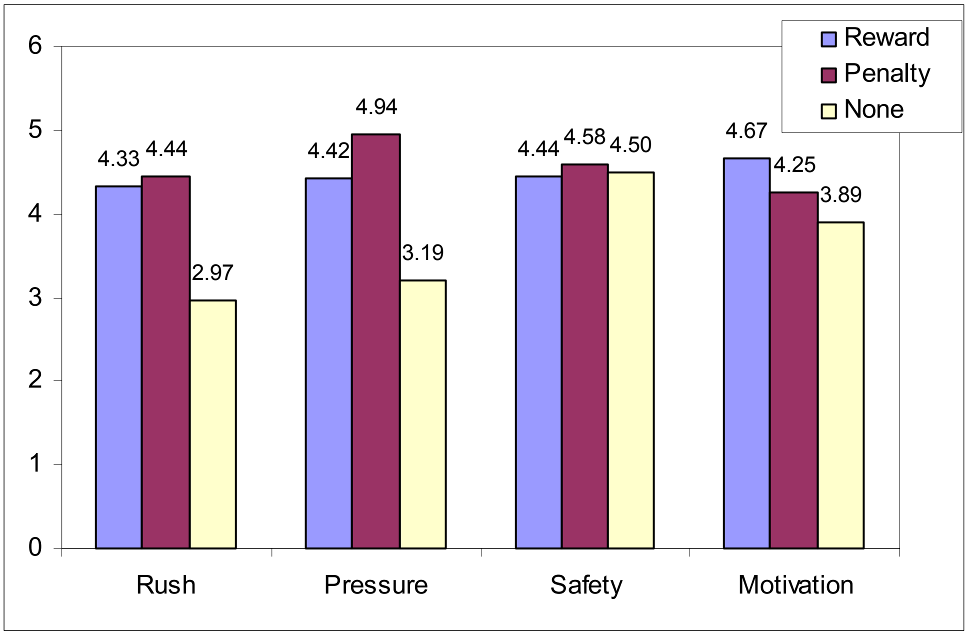


Figure 4.16: Post-experiment results.

4.8.3 Additional Correlation Analyses

Correlation analysis was conducted with different variables to identify any possible correlation among variables. The summary of the additional correlation analyses is presented in Table 4.14.

Variables	Correlation Coefficient
General risk perception & internal locus of control	0.5035
General risk perception & external locus of control	-0.0663
General risk perception & self-efficacy	0.4071
General risk perception & risk-taking behavior	-0.1063
General risk perception & construction risk perception	0.4669
Construction risk perception & internal locus of control	0.3840
Construction risk perception & external locus of control	0.1026
Construction risk perception & self-efficacy	0.3274
Construction risk-taking behavior & internal locus of control	0.1791
Construction risk-taking behavior & external locus of control	-0.0822
Construction risk-taking behavior & self-efficacy	0.0229
Construction risk perception & construction risk-taking	-0.0840

Variables	Correlation Coefficient
behavior (at item level)	
Risk-taking behavior & safety Training	-0.3324
Risk-taking behavior & post-experiment risk perception	-0.4240

Table 4.14: Additional correlation analyses.

4.9 Participants' Explanation on Safe and Unsafe Behaviors

When participants were asked for reasons behind their safe and unsafe behaviors during the experiment, they indicated numerous reasons as presented below. Table 4.15 shows the overview of the reasons. Note that these responses were retrieved from the post-experiment interview.

Reasons	No. of Americans	No. of Asians	No. of Latin Americans
Safe behavior			
Wore safety glasses to protect their eyes.	1	3	2
A habit to wear safety glasses.	0	0	1
Wore gloves to protect hands or help handle the tools.	1	2	1
A habit to wear gloves.	1	0	1
Gloves were needed for this type of work.	0	1	0
Wore earplugs because it was loud.	1	1	1
Safe behavior because safety training.	5	2	0
Awareness as a part of the study.	1	0	0
Inconveniencing for the researcher if injury occurred.	1	0	0
Believed that practice unsafe behavior would be penalized.	2	0	0
A habit to wear protective equipment.	0	2	0
Unsafe behavior			
Safety glasses got foggy.	2	1	3
Forgot to wear safety glasses	0	2	0
Safety glasses got into the way of/did not fit over eye glasses.	3	2	2
Eye glasses were enough to protect eyes.	0	2	2
Safety glasses were not needed.	0	0	3
Gloves would slow down the pace/ got in the way	3	0	0
Gloves were not needed	0	0	3
Gloves were too bulky and uncomfortable	4	3	3
Noise was not loud enough for earplugs.	4	9	5

Reasons	No. of Americans	No. of Asians	No. of Latin Americans
Used to loud noises.	1	0	0
Earplugs were uncomfortable	0	1	0
Did not wear protective equipment because he was in a hurry	1	0	0
Used to working with wood/ no need for this type of experiment.	3	0	0
Hassle to wear the protective equipment	1	0	0

Table 4.15: Summary of reasons for safe and unsafe behaviors.

Americans

Reasons for safe behavior:

- A participant (AM1) wore safety glasses because he did not want saw dust or flying particles in his eyes.
- A participant (AM1) wore gloves because he did not want his hand to get caught by splinters or other small particles. Another participant (AM5) indicated that wearing gloves was a habit and he wears gloves whenever they are available to him.
- One participant (AM6) used earplugs because upon completion of the first task, he realized that it was quite loud in the lab and thus he decided to wear the earplugs for the rest of the experiment.
- Several participants (AM2, AM4, AM6, AM10, and AM12) indicated that the reason that they performed safely or wore personal protective equipment was because of the safety training provided prior to conduction the experiment.
- Participants (AM2 and AM4) said they were cautious and aware that they were part of a research study and had to perform safely. One participant (AM2) indicated that he did not want to get hurt because of the inconvenience it would have caused the researcher.
- Two participants (AM3 and AM6) thought that they would be penalized if they engaged in unsafe behaviors.

Reasons for unsafe behavior:

- Two participants (AM5 and AM6) indicated that the safety glasses got foggy or wet because of the sweat. This made the glasses hard to see through and therefore the participants decided to take the safety glasses off.
- Several participants (AM4, AM7, and AM9) stated that they did not wear safety glasses because the safety glasses got in the way of their eye glasses or they did not fit over top of the participants' eye glasses. They also felt that their eye glasses were sufficient enough to protect their eyes from flying particles during the experiment.
- Several participants (AM2, AM3, and AM4) indicated that they did not wear gloves because the gloves would slow them down or would get in the way. Many participants (AM3, AM6, AM7, and AM9) indicated that the gloves were too bulky and were not comfortable. Wearing the gloves also made it much harder to be accurate and harder to pick up small stuff such as nails, *etc*.
- Several participants (AM1, AM5, AM9, and AM11) did not wear earplugs because they thought that the sound in the lab was not very loud or was not constant enough to cause damage to their hearing. One participant (AM4) thought that it was not appropriate to wear earplugs in a room. Another participant (AM7) indicated that he was used to loud noises.
- One participant (AM4) was in a hurry, and therefore he forgot about practicing safety.
- Two participants (AM3 and AM11) indicated that they were used to working with wood and thought that they did not need wear any personal protective equipment. Another participant (AM12) indicated that it was a hassle to wear the protective equipment.
- One participant (AM12) did not feel that there was a need to wear personal protective equipment in this experiment.

Asians

Reasons for safe behavior:

- Several participants (AS1, AS5, and AS9) wore safety glasses to protect their eyes from any flying particles that might occur during the experiment. They indicated that they were very cautious about protecting their eyes. However, two participants (AS6 and AS7) complained that the safety glasses got foggy.
- Several participants (AS1, AS7) said that they wore gloves to protect their hands from splinters and sharp objects and also to prevent blisters. Another participant (AS12) indicated that the gloves helped him handle the tools more comfortably and with less concern about injuring himself. A participant (AS5) thought that wearing gloves made him feel more comfortable working with the wood.
- One participant (AS8) indicated that he wore earplugs because it was too loud in the lab during the experiment.
- Although the safety glasses and the gloves were not comfortable, a participant (AS6) still indicated that he wore them because he thought that he needed them for this type of work.
- Participants (AS4 and AS7) wore personal protective equipment because of the safety training. Others (AS4 and AS8) indicated that it is a habit to wear protective equipment when engaging in these types of activities.

Reasons for unsafe behavior:

- A participant (AS3) said that the safety glasses got foggy and wet and therefore he took them off. Also at times he did not wear safety glasses because he forgot. Another participant (AS11) said that he was in a hurry and simply forgot to wear them.
- Several participants (AS10, AS12) did not wear safety glasses because they felt that their eye glasses were sufficient enough to protect them from

flying particles. Also wearing the safety glasses over top of their eye glasses was uncomfortable and made it hard to see what they were doing.

- Several participants (AS6, AS9, AS10) did not wear gloves because they were too big, or uncomfortable, and were inconvenient.
- Several participants (AS1, AS3, AS5, AS6, AS7, AS9, AS10, AS11, AS12) did not wear earplugs because they thought it was not very loud in the lab, the noise was not constant enough, or because they were only working for a few hours which was not sufficient enough to cause damage to their hearing. A participant (AS5) indicated that the earplugs were uncomfortable.

Latin American

Reasons for safe behavior:

- One participant (LA3) wore safety glasses because he said it was a habit. Two participants (LA9 and LA11) indicated that he wore them to help protect his eyes from flying particles.
- One participant (LA1) wore gloves because he said it was a habit. Another participant (LA11) said he wore the gloves to help prevent him from getting cuts or injuries from using the tools.
- One participant (LA9) wore earplugs because the noise in the lab was too loud.
- Two participants (LA9 and LA12) wore personal protective equipment because of the safety training provided prior to the experiment or they thought it was a requirement for this study.

Reasons for unsafe behavior:

- Two participants (LA1 and LA10) indicated that they did not wear safety glasses because they had eye glasses and felt that their eye glasses were sufficient enough to protect their eyes. Wearing safety glasses over top of their eye glasses was awkward, made it hard to see, the safety glasses got foggy, and were uncomfortable. Participants (LA2, LA6) indicated that they felt the task was not risky enough to require use of safety glasses. One participant (LA12) took the safety glasses off during the experiment because nothing had happened up to that point and he felt it was safe to take them off. Another participant (LA5) noted that safety glasses usually get foggy and uncomfortable.

- Several participants (LA2, LA5 and LA7) did not wear gloves because they felt the tasks were not that risky. The gloves were also too bulky and did not fit their hands well.
- Several participants (LA1, LA5, LA6, LA7, and LA11) indicated that they did not wear earplugs because they thought it was not loud enough in the lab to require the use of earplugs.
- One participant (LA2) did not wear personal protective equipment because he was used to not working with them on. Another participant (LA4) did not realize that the equipment was provided.
- One participant (LA7) stated that the reason he did not wear any protection was because he was from South America.

The majority of participants decided to wear personal protective equipment because (1) they wanted to protect themselves from injuries during the experiment, (2) safety training, and (3) it was their habits. The majority of participants decided not to wear personal protective equipment because (1) they thought it was uncomfortable, (2) it was not necessary, and (3) it would hinder them from performing their best. Many participants also indicated that if the personal protective equipment was more comfortable, they would have worn it.

Chapter 5: Discussion

5.1 Effects of Reward systems

The results showed that offering rewards to participants increased their motivation to work when compared to a penalty ($p<0.05$) and no reward or penalty schemes ($p<0.01$), however, it did not result in better performance (higher quality or less time to finish the tasks). On the other hand, a penalty did not increase participants' motivation but participants performed better by producing higher quality tasks when compared with rewards and no reward or penalty schemes ($p<0.05$). Participants also used less time to finish the tasks when compared to no reward or penalty scheme ($p<0.05$). However, participants felt they were rushed and felt pressure to work fast during the rewards and the penalty schemes more than when there was no reward or penalty ($p<0.05$). These findings are supported by the goal-setting theory that people work harder when goals are in place (Lock & Latham, 1984). For this study, the goals were to receive the rewards or not to be penalized. Since the time used to finish the tasks was one of the two criteria that determined rewards and penalty, participants probably felt they had to work fast to achieve the goals. Even though a penalty led to better performance, participants' motivation was not higher when compared with rewards and no reward or penalty schemes. Also if people were to work under great pressure for a long period of time, it is suspected that the effect of penalty in the long run is more negative than positive.

The results showed that the effects of rewards, a penalty, and no reward or penalty on risk-taking behavior were not statistically significant. When participants were asked to rate how careful they were in terms of their own safety during the experiment, no difference was found between all three reward systems ($p>0.1$). These results contradicted reports from a study conducted by Sawacha et al. (1999), which indicated that rewards lead to higher risk-taking behavior. Sawacha et al. (1999) reported a strong relationship between productivity bonus pay and unsafe behavior at construction sites. They suggested that bonus pay is an incentive for workers to work faster and therefore engage in unsafe behavior. Their suggestions that people would work faster when an incentive is offered were consistent with the findings in this study that rewards caused participants' to feel more pressure to rush and work faster. Since the rewards were enough to make participants feel pressured to rush and work fast, the researcher believes that the rewards offered to participants were enough to trigger any differences in risk-taking behaviors. One possible explanation that no difference in risk-taking behavior was found among reward systems could be because the tasks used in this study did not contain enough possibility for participants to take more risk. The effects of reward systems on risk-taking behavior may have been reduced by the low possibility of risky behavior. Therefore, differentiation between reward systems was minimized. It is suspected that if the tasks contained more opportunities for participants to take risks, differences in risk-taking behavior would have been significant. Note that the researcher attempted to increase risk within the study with the addition of cutting, drilling, and driving screws to the tasks. Participants were required to use a handsaw and a power drill along with a hammer to complete the tasks. The challenge was that risks had to be introduced in the study while at the same time it was unethical to put participants in an unsafe environment and the study had to be approved by the IRB.

5.2 Effects of Culture

The ANOVA (Table 4.6) showed that there were differences ($p<0.01$) in risk-taking behavior between participants from different cultures. Hypothesis tests using $\alpha=0.05$ found that Americans had higher risk-taking behavior than Asians ($p<0.001$), Latin Americans had higher risk-taking behavior than Asians ($p<0.0001$), and no difference in risk-taking behavior between Latin Americans and Americans was found ($p>0.1$). When tests were conducted for each reward system scheme, the results were inconsistent except for the comparison between Americans and Latin Americans. No difference was found between Latin Americans and Americans ($p>0.1$). Mixed results were found between Asians and Americans, and Asians and Latin Americans. When there was no reward or penalty, Americans had higher risk-taking behavior than Asians ($p<0.05$). When rewards were offered or when a penalty was in place, Asians' and Americans' risk-taking behaviors were not different ($p=0.0735$, $p=0.0931$ respectively). Note that these results approached significant. With rewards or no reward or penalty, Latin Americans had higher risk-taking behavior than Asians ($p<0.05$). With a penalty in place, there was no difference between Latin Americans and Asians ($p = 0.0697$). This result also approached significant.

If $\alpha=0.1$ was used, the results would have been consistent across all reward systems, and would also have been consistent with the overall results (all reward systems considered). Americans' and Latin Americans' risk-taking behaviors were not different. Americans and Latin Americans had higher risk-taking behaviors than Asians. Since this study was more of an exploratory study, these results were considered.

These findings on risk-taking behavior from the experiment differed from the statistics reported by the ILO. [d]ILO (2006) reported that fatality rates in the construction industry in many countries in Asia and Latin America are higher than in the U.S. (see Appendix A).

What were the reasons that made Asian participants behave differently than those in their home countries? What were the reasons that made Americans and Latin Americans behave statistically the same when Latin Americans were expected to have higher risk-taking behavior? The researcher realized that there were many elements that could contribute to the differences. The sociotechnical system and the accident prevention model were used as frameworks to analyze these differences. With the experiment setting, the technological subsystem and the organization design components of the sociotechnical system were different from the work environment in Asia and Latin America. These two components influenced the behavior of the participants (personnel subsystem) and made them behave differently than those in their home countries. Safety training, personal protective equipment, and the researcher were the elements which were identified as behavior and structure modification components of the accident prevention model. Figure 5.1 presents how these elements affected the participants' behavior within the sociotechnical system framework.

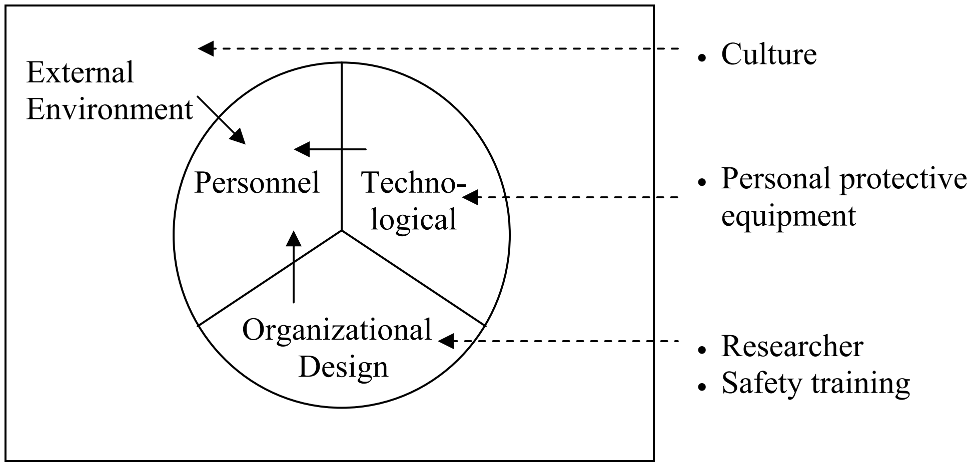


Figure 5.1: Elements that could influence the changes in participants' behaviors (the sociotechnical model was modified from Hendrick as cited in Kleiner, 1998).

[e]ILO (2005) reported that injury rates in industrialize countries are decreasing while the rates are increasing in developing countries. Twenty-two out of twenty-four Asian and Latin American participants were from developing countries (developing countries were identified by a list from the World Bank (2007)). The researcher suspected a lack of safety rules, regulations, and governments' enforcement contributes to a higher risk-taking behavior of construction workers in Asia and Latin America. Safety rules, regulations, and enforcement from the governments have a great impact on safety at a construction site (Teo, Ling, & Chong, 2005). Since the governments fail to enforce safety rules and regulations, the companies may neglect to provide their workers with safety training and the proper safety equipment. Companies may have a lesser responsibility toward their employees when an accident occurs. For example, companies may only need to spend a small amount of money, if any at all, to cover the workers' medical bills. The cost of finding a worker to replace an injured worker may also be small, since there are plenty of workers in the workforce.

During the experiment, the elements mentioned earlier influenced participants' behaviors, which helped reduce risk-taking behavior which otherwise were suspected to be higher. The researcher provided participants with safety training which helped participants be aware of safe and unsafe behaviors. The safety training was rated at 3.82

(on a scale of 1-5) by the participants on how helpful it was for keeping them safe during the experiment. The researcher also provided participants with personal protective equipment (safety glasses, gloves, and earplugs). As mentioned earlier, the safety training and personal protective equipment are probably not provided to workers in Asia and Latin America. These elements would contribute as the "organization culture" in an organization. With these behavior and structure modification components provided to participants, the risk-taking behavior of Latin Americans, which was expected to be higher, had been suppressed to the same level as Americans. Asians' risk-taking behavior was also suppressed. However, certain aspects of Asian culture may also contribute to a much lower risk-taking behavior of Asian participants. Also certain aspects of American and Latin American cultures may contribute to the higher risk-taking behavior as well. The aspect of culture is explored in the next section to gain a better understanding of how it might have played a role in influencing an individuals' risk-taking behavior.

Before discussing how culture plays a role in influencing risk-taking behavior, the reader should keep in mind that this research was exploratory. The researcher only attempted to explore whether the components of culture identified by Hofstede could be used to gain a better understanding of individuals from different cultures. Also as advised by Johnson (1991) that to draw the conclusion that "culture causes X" may not be appropriate in a cross-cultural risk study. This is because culture is complex and to conclude that a culture component causes people to have higher risk-taking behavior is likely impossible.

As mentioned earlier in chapter 2, there was no evidence as to how Hofstede's cultural dimensions connect to risk-taking behavior. Figure 5.2 shows participants' scores on Hofstede's cultural dimensions. Figure 5.3 shows Hofstede (2001)'s original scores of the countries represented by participants in this study. As mentioned earlier in Chapter 2, LTO scores were not provided because Hofstede (2001) did not provide LTO scores for most of the countries.

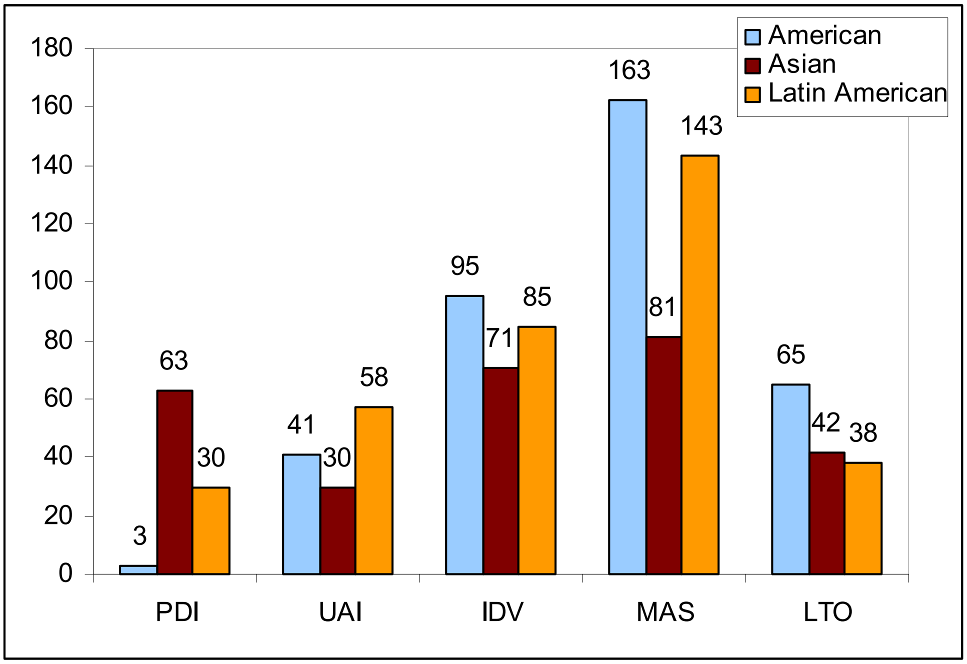


Figure 5.2: Participants' scores on Hofstede's cultural dimensions.

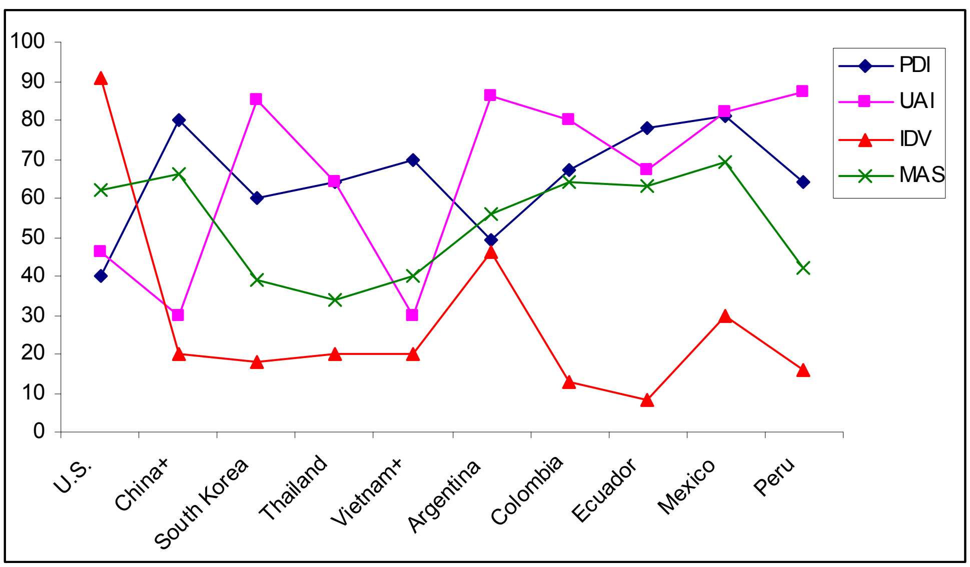


Figure 5.3: Hofstede's scores of countries represented by participants in this study.

The cultural dimension trend was observed that Americans' and Latin Americans' scores were more alike than Asians' scores, except the long term orientation (LTO) in which Americans' score was the highest followed by Asians and Latin Americans. The statistical tests with $\alpha = 0.05$, shown in Table 4.4, showed that Asians had a higher power distance index (PDI) than Americans and Latin Americans. Americans had a higher masculinity index (MAS) than Asians and Latin Americans. There was no difference found among the three cultures for the uncertainty avoidance index (UAI) and the individualism index (IDV). Americans had a higher long-term orientation (LTO) than Asians and Latin Americans. When $\alpha = 0.1$ was used for testing, Latin Americans also had higher MAS than Asians ($p<0.1$).

Before discussing how these scores may be related to risk-taking behaviors, cultural dimension scores provided by Hofstede were compared with the results from this study. Note that only the trends from Hofstede's scores can be used to discuss similarity and differences since variances and sample sizes were not available. The trends of UAI and MAS scores were found to be similar with the results from the experiments.

It was suspected that UAI would have the highest correlation with risk-taking behavior, *i.e.* people with high UAI would have lower risk-taking behavior than people with low UAI. However, results from this experiment showed no difference in this dimension. Americans' and Latin Americans' scores were not statistically different from Asians. Instead, PDI and MAS showed the possibility of correlation with risk-taking behavior. Note that this is consistent with one of the two dimensions (PDI and IDV) identified by Martin (2003) that contribute to the differences in risk perception associated with hazardous situations. The statistics tests showed that Asians' PDI was higher than Americans and Latin Americans. With high power distance, Asian participants may have felt that they had less control and power in the experiment than the researcher, who was also Asian. Therefore, they tended to obey and follow what they had been told or trained to do (Hofstede, 2001). American and Latin American participants may not have felt the power differences between the researcher and themselves as strongly as the Asian participants did, therefore they may have made decisions based on their own opinions and with less regard to what they had been trained to do. The results from this experiment also have shown that Americans and Latin Americans have a much higher masculinity index than Asians. It could be possible that people who had a high masculinity index felt more assertive and tough (Hofstede, 2001). Therefore they were likely to have higher risk-taking behavior.

Even though culture may influence an individual's risk-taking behavior, the results from this study showed that an individual's risk-taking behavior could be altered and suppressed by providing them with proper safety training and safety equipment. Customized safety training for people from different cultures would be useful because the culture elements that contribute to high risk-taking behavior would be able to be addressed.

5.3 Correlation among Variables

Correlation analysis was conducted between variables. The results are presented earlier in Chapter 4 (hypothesis test 7-11 and Table 4.14).

General risk perception and construction risk perception

Hypothesis 12 tested whether the participant's general risk perception was the same as his construction risk perception. The results showed that they were different, and the construction risk perception was higher than the general risk perception. The correlation analysis was conducted between the two variables and found $r = 0.4698$, which indicated a weak positive correlation. It could therefore be concluded that general risk perception was similar to construction risk perception but they were not the same. Individual risk perception was unique to each specific field.

Risk perception and risk-taking behavior

Correlation analysis was conducted between

(1) construction risk perception and risk-taking behavior.

(2) construction risk perception and construction risk-taking behavior.

(3) general risk perception and risk-taking behavior.

(4) post-experiment risk perception and risk-taking behavior.

No relationship was found between the first three pairs. For the fourth pair, a weak negative correlation ($r = -0.424$) was found between post-experiment risk perception and risk-taking behavior. These results are consistent with the findings from other studies conducted by Brown (2005), Rundmo (2003), and Turner et al. (2004), which indicated that no relationships were found between risk perception and risk-taking behavior. However, the theory of risk compensation suggests otherwise (Adams, 1995). This theory suggests that an individual's risk-taking behavior is influenced by the individual's risk perception. The difference in these findings can be explained by the fact that an individual's risk perception is not the same across all situations. This is supported by the result from hypothesis 12 which found that construction risk perception differed from and was higher than general risk perception. The researcher concluded that risk perception was unique to each situation and had some influence on the individual's risk-taking behavior on that specific field.

Risk-taking behavior and locus of control

From hypothesis 10, the results showed that there was no correlation between locus of control (internal or external) and risk-taking behavior, even though it was suspected that a correlation would exist between these two variables like many previous studies had found (Martin, 2002; Montag &Comrey, 1987; Salminen & Klen, 1994; Wuebker, 1986). However, there are also many studies that found no relationship between these two variables (Iversen & Rundmo, 2002; Rolison & Scherman, 2002; Barber, 1995), which is consistent with the finding in this study. A possible reason that no relationship was found in this study might be because the locus of control used here was not specific to the risk-taking behavior in the construction industry, as suggested by many researchers that the locus of control of an individual is specific to each situation (Jones & Wuebker, 1985; Spector, 1988; Paulhus & Christie, 1981; Montag & Comrey, 1987). The researcher concluded that the general locus of control cannot be used to predict individuals' construction risk-taking behavior. Further investigation is needed to examine whether locus of control that is more specific to the situation is able to predict situation-specific risk-taking behavior.

Risk-taking behavior and self-efficacy

From hypothesis 11, the results showed that there is no correlation between self-efficacy and risk-taking behavior. The self-efficacy items used in this study were selected from general self-efficacy questionnaires developed by Sherer and Maddux (1982). A possible reason that no relationship was found was because the self-efficacy scale used in the study was generic, and therefore could not be used to predict all types of risk-taking behavior, including risk-taking behavior in construction. Many researchers have suggested that self-efficacy is situation specific (Murdock et al., 2005; Martin et al., 1995; Perraud, 2000; Slanger & Rudestam, 1997). It can be concluded that general self-efficacy may not be used to predict risk-taking behavior in the construction industry. Further investigation is needed to examine whether self-efficacy that is more specific to the situation is able to predict situation-specific risk-taking behavior.

Risk-taking behavior with quality and time

No correlation was found between the quality of the task and the risk-taking behavior. No correlation was found between the time used to finish a task and the risk-taking behavior. Many participants indicated that wearing gloves prevented them from performing the task with the amount of accuracy required. The results showed that wearing personal protective equipment did not hinder a participant's ability to perform well, in terms of quality or time. Participants who engaged in riskier behavior did not finish the tasks any sooner than the participants who took less risk.

Chapter 6: Conclusions

6.1 Conclusions

Limited statistics retrieved from [d]ILO (2006) indicate that the fatality rates in the construction industry in countries in Asia and Latin America are mostly higher than in the U.S. The [c]ILO (2006) also reported that injury rates in developing countries are increasing, while the rates are decreasing in developed countries. In the U.S., the Bureau of Labor Statistics (Richardson, 2005) also raises concerns that the fatality rate of foreign-born Latin American workers in 2004 was higher than the fatality rate of all workers combined. With these statistics and reports, this study was initiated to investigate whether workers from the U.S., Asia, and Latin America have the same level of risk-taking behavior. It was suspected that Latin Americans would have the highest risk-taking behavior, followed by Asians, and Americans. Reward systems were identified as triggers that could make the differences in risk-taking behavior even more pronounced.

The research found that Americans and Latin Americans had higher risk-taking behavior than Asians. No difference in risk-taking behavior was found between Americans and Latin Americans. There are several explanations that could contribute to the differences between the results of this study and what had been reported.

First, [e]ILO (2005) reported that injury rates in industrialized countries are decreasing while the rates are increasing in developing countries. Most of Asian and Latin American countries are developing countries. Laws, rules, and regulations on safety are likely not as advanced and well-developed as in the U.S. Governments must put safety in the workplace as one of their top priorities. Tougher laws, rules, regulations and enforcement from governments will help reduce injuries and fatalities (Teo et al., 2005).

Second, safety training and personal protective equipment (safety glasses/goggles, gloves, and earplugs) were provided to participants during the experiment. The researcher believes that the safety training and personal protective equipment provided during the experiment reduced and suppressed the risk-taking behavior of all participants who otherwise would have shown higher risk-taking behavior. Safety training and the equipment were the means for changes in the participant's behavior. Many participants indicated that the reasons for not wearing safety glasses were because they were not comfortable, or they got foggy and wet during experiment. Many also did not wear gloves because they thought the gloves were too bulky and were not as comfortable as working with their bare hands. Better safety equipment would increase the likelihood that workers would wear personal protective equipment when performing the tasks. Equipment manufacturers should incorporate these elements when designing and developing better personal protective equipment, to provide people with better equipment that eliminates all of these flaws.

Lastly, cultures may contribute to these differences. Higher PDI was observed for Asian participants compared to their counterparts. Also note that the researcher was an Asian, and therefore PDI might even be more pronounced with Asian participants. The researcher concluded that individuals from high PDI culture tended to have less risk-taking behavior in construction. On the other hand, low MAS was observed in Asian participants when compared to Americans and Latin Americans. The researcher concluded that individuals from low MAS culture tend to have lower risk-taking behavior in construction.

Even though culture may influence individuals' risk-taking behavior, the results from this study showed that an individual's risk-taking behavior could be altered and suppressed by providing them with the proper safety training and safety equipment. Many researchers also have suggested that effective safety training would help reduce injuries and fatalities (Teo et al, 2005). Customized safety training for people from different cultures would be useful because the culture elements that contribute to high risk-taking behavior could be addressed.

The U.S. Bureau of Labor Statistics (Richardson, 2005) reported that the fatality rate of foreign-born Latin American workers (in the U.S.) was much higher than the rate of all U.S. workers. The results of this study suggested that it was not because of the culture. Americans' and Latin Americans' risk-taking behaviors were not different. It is suspected that other sources may contribute to this difference. Some of the possible sources are (1) safety training may not be provided to a day job worker, (2) safety training may not be provided in Spanish, making it difficult for Latin American workers who do not speak English to understand and follow, (3) difficulty of communication at construction sites may increase the risk level for Latin American workers (*ex.* warning signs may only available in English), and (4) Latin American workers may mostly work in the jobs that contain riskier activities in nature than Americans (Greenhouse, 2001; Ortega-Wells, 2006; Tucker, 2007).

The results showed that the effects of reward systems on risk-taking behavior were not statistically significant. When participants were asked to rate how careful they were in terms of their own safety during the experiment, no difference was found between all three reward systems ($p>0.1$). These results contradicted with reports from a study conducted by Sawacha *et al.* (1999), which indicated that reward systems lead to higher risk-taking behavior. Sawacha *et al*. (1999) reported a strong relationship between productivity bonus pay and unsafe behavior at construction sites. They suggested that bonus pay is an incentive for workers to work faster and therefore engage in unsafe behavior. Their suggestions that people would work faster when an incentive is offered was consistent with the findings in this study that reward systems made participants' feel pressure to rush and work faster. One possible explanation that no difference in risk-taking behavior was found among reward systems is because the tasks used in this study did not contain enough possibility for participants to take more risk. The effects of reward systems on risk-taking behavior may have been reduced by the low possibility of risky behavior. Therefore, differentiation between reward systems was minimized. It is suspected that if the tasks contained more opportunities for participants to take risk, differences in risk-taking behavior would have been significant.

The researcher concluded that risk perception is situation-specific and has some influence on the individual's risk-taking behavior on that particular situation but cannot be used to predict risk-taking behavior. General locus of control and general self-efficacy cannot be used to predict risk-taking behaviors of the individuals. These findings are consistent with many studies that explore locus of control (Iversen & Rundmo, 2002; Rolison & Scherman 2002; Crisp & Barber, 1995), and many researchers that suggested self-efficacy is situation specific (Murdock et al., 2005; Martin et al., 1995; Perraud, 2000; Slanger & Rudestam, 1997).

This study also found no relationship between risk-taking behavior and productivity, in terms of both time and quality. Participants with higher risk-taking behavior did not perform any faster than those who had lower risk-taking behavior. No difference was found in the quality of the finished products produced by individuals with different levels of risk-taking behavior.

6.2 Limitations

- Participants were drawn from the pool of the student body of Virginia Tech due to the nature of the research that required international participants, and the limited research budget.
- Asian and Latin American participants had been exposed to American culture. However, these Asian and Latin American students were the best representatives from their culture when compared to other available participants (*i.e.* people that have visited those countries).
- The participants were limited to a male population of 18-35 years old; therefore, the results of this study can only be generalized to the male population between the ages of 18-35 in the construction industry.
- Even though there are many types of reward systems, due to limited resources and time, only three types of reward systems were used in this study. The three reward systems were rewards, a penalty, and no reward or penalty. These three reward systems represent Skinner's reinforcement theory: positive reinforcement, penalty, and no reward, respectively.
- The study was limited to only individual reward systems. Team reward systems were not considered.
- The majority of the risk-taking behaviors in this study were drawn from participants' behavior on whether or not they wore personal protective equipment (*i.e.* safety glasses/goggles, gloves, and earplugs). Inducing risk-taking behavior in this study was limited by the fact that it is experimental, and thus the researcher was required to ensure that the participants would not severely injure themselves. Therefore, the risk-

taking behavior results from this study are more related toward the use of personal protective equipment.

6.3 Lessons Learned

There were two major challenges conducting cross-cultural risk research. First, inducing risk in the research was limited by many factors. The researcher wanted to conduct an experiment that contained similar risks to the real world, but it was unethical to knowingly put participants in harms way. It was also the duty of the research, as a human being, to warn the participants of any danger that they may cause to themselves. Therefore, recreating risks similar to those found in the real world was difficult. The study in this field may have to be mainly carried out by (a) using video recorders to record actual behaviors at construction sites (b) using surveys to retrieve information, and (c) investigating/interviewing construction workers to identify the phenomena of safe and unsafe behaviors.

Another major challenge was the difficulty of recruiting participants from the targeted countries. This type of research is mostly limited by the budget. Researchers would opt out of conducting a cross-cultural study and turn more into domestics study. This research showed that the cross-cultural research could be done, however more effort is needed from the researcher to identify and recruit qualified participants. For future studies, a great option would be to collaborate with studies between different research centers around the world so that data could be collected from each country.

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Appendices

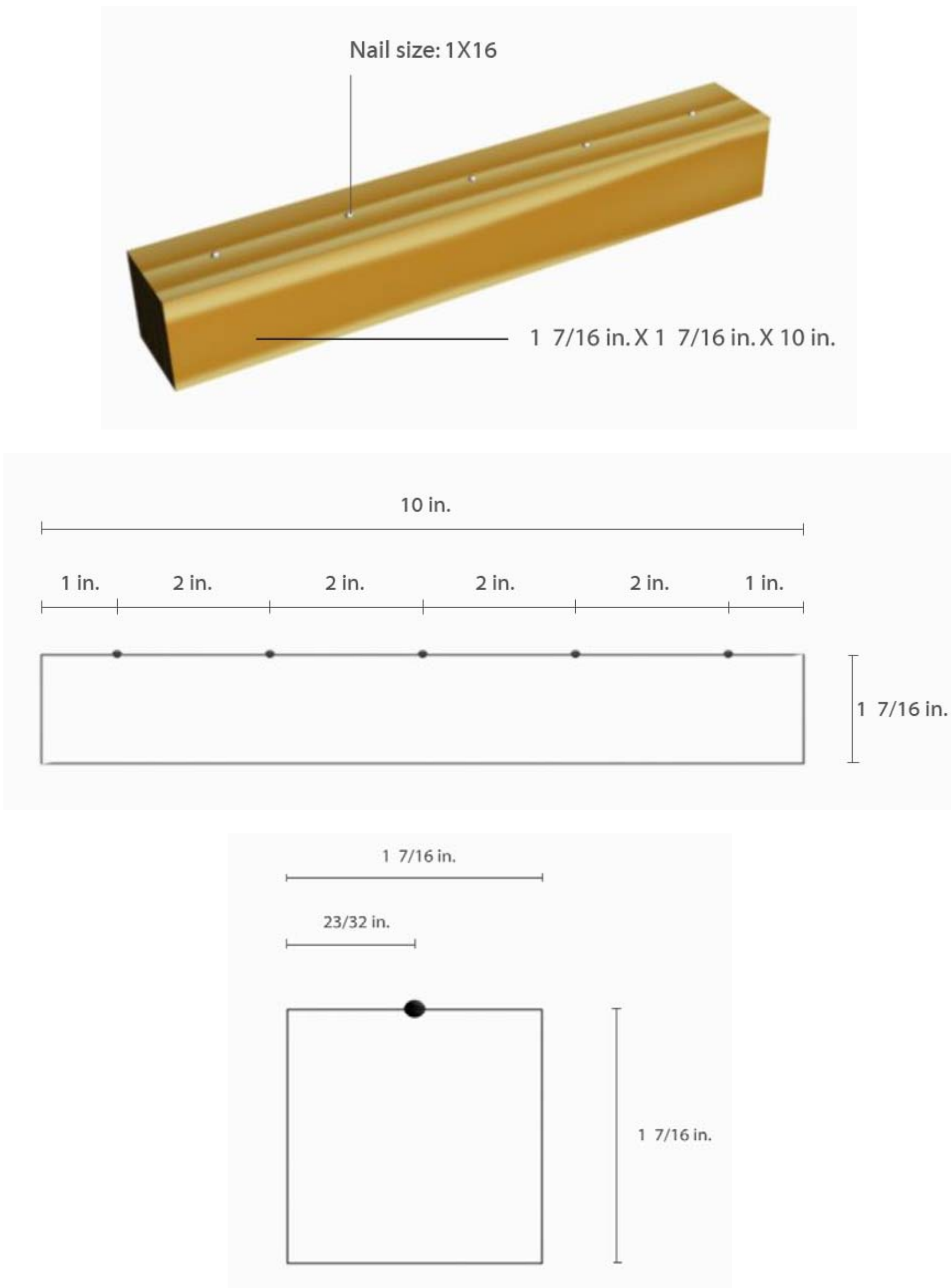
Appendix A: Fatality statistics in the construction industry

Country	Year								
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
United States	15	14	14	15	14	13	13	12	12
Asia									
Hong Kong*	135.7	93.4	77.2	88.6	90.2	59	52.3	64.2	51.5
Singapore*	29.5	33.4	37.6	N/A	N/A	N/A	N/A	N/A	N/A
South Korea	32	32	31	36	N/A	N/A	N/A	N/A	N/A
Taiwan	20.8	21.1	25.9	25.4	20.3	22.3	21	N/A	N/A
Latin America									
Argentina	N/A	N/A	27.9	23.1	47.1	23.8	N/A	N/A	N/A
Bolivia	19.8	38.5	71.1	11	N/A	N/A	N/A	N/A	N/A
Brazil*	16.7	18.7	14.1	19.7	18.5	26.4	N/A	N/A	N/A
Columbia	23.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Costa Rica	N/A	N/A	8.2	9.5	31.5	26.8	N/A	N/A	N/A
Honduras*	N/A	N/A	N/A	4620	N/A	N/A	N/A	N/A	N/A
Nicaragua	17	0	0	19	39	51	36	108	39
Panama*	N/A	27	N/A	52	N/A	N/A	N/A	N/A	N/A

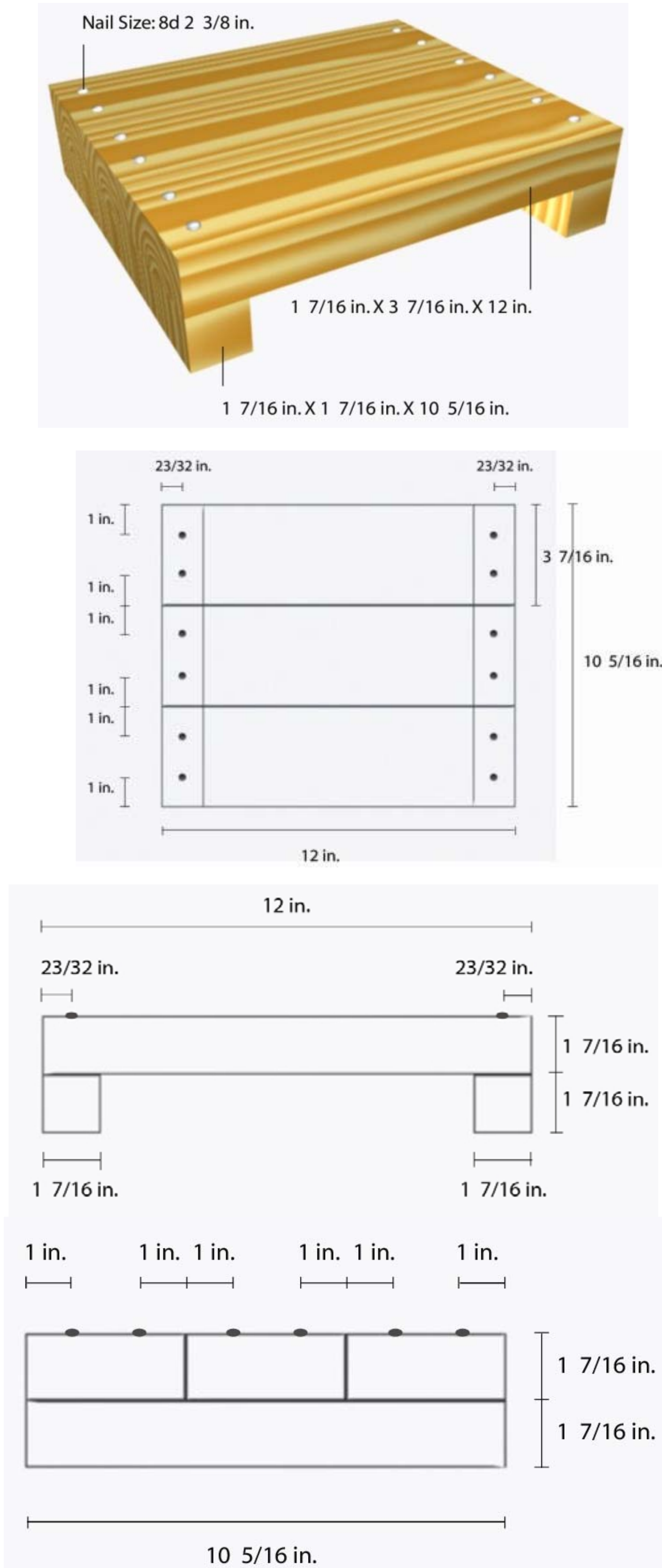
*Number of fatality per 100,000 employees

Table A.1: Number of fatalities per 100,000 workers insured ([d]ILO, 2006).

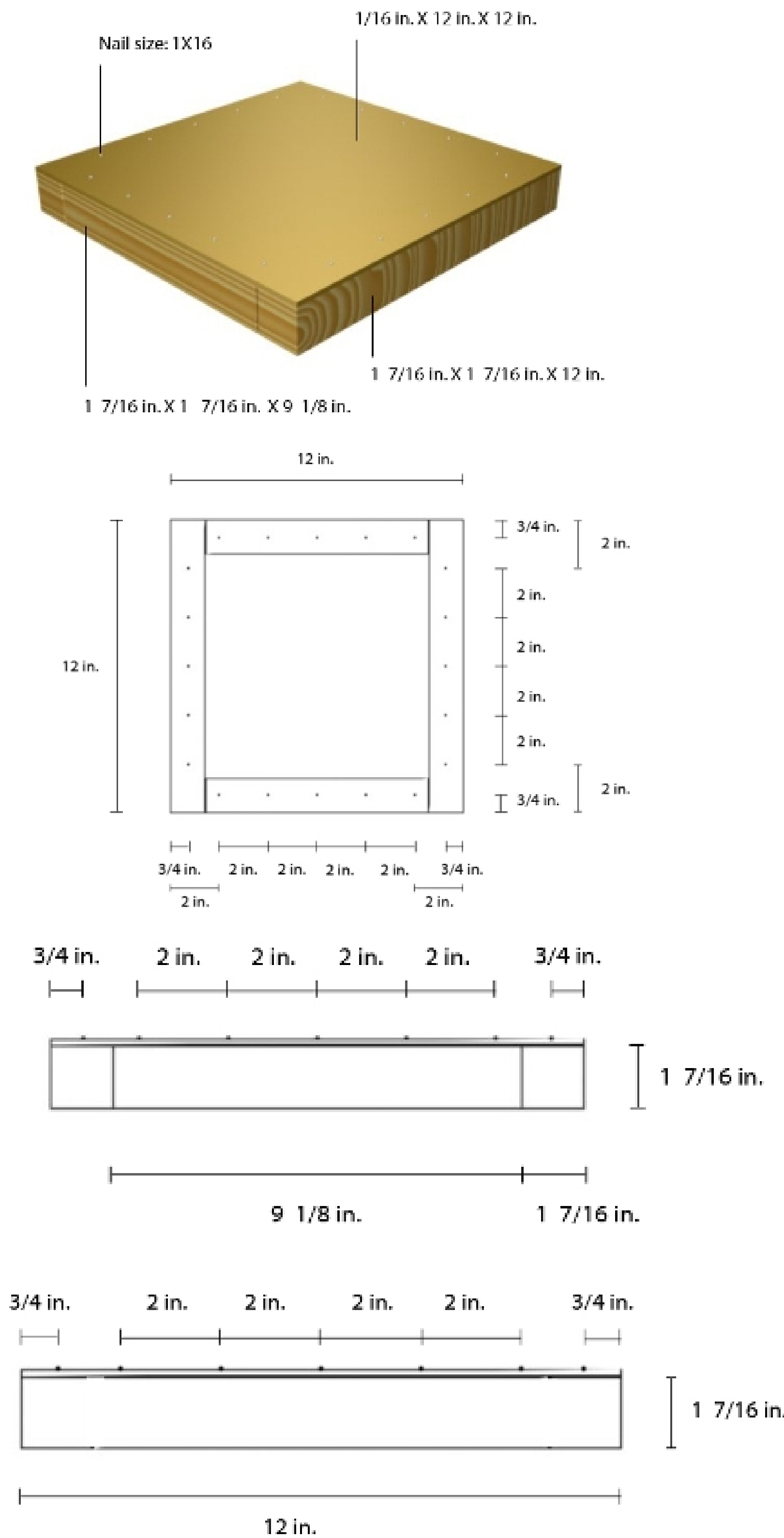
Appendix B: Pilot study I



<u>Figure B.1: Pilot I-3D view and dimensions for training task.</u>



<u>Figure B.2: Pilot I-3D view and dimensions for task A.</u>



<u>Figure B.3: Pilot I-3D view and dimensions for task B.</u>

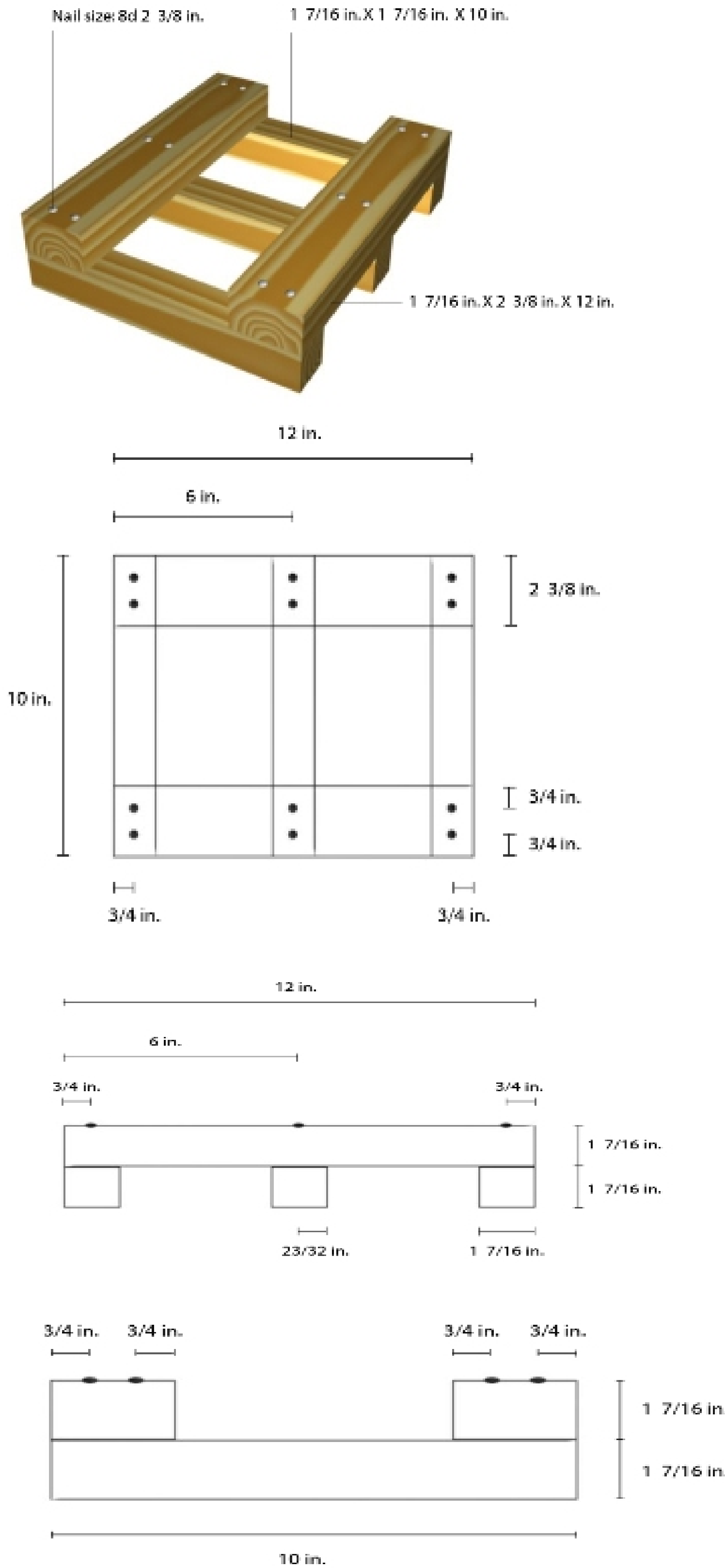


Figure B.4: Pilot I-3D view and dimensions for task C.

Appendix C: Screening Questionnaire

Please answer each question as accurately and as honestly as possible. Your information is strictly confidential and will help us determine your eligibility for the study. If you have any questions, please contact Sasima at ConstructionStudy@vt.edu.

Section 1: Demographic Questions

1. Name:
2. Please provide your email address or phone number:
3. Gender: __Male __Female
4. Age:
5. Ethnicity (race):
    - African American
    - Asian
    - Asian American
    - European
    - Caucasian American
    - Latin American (U.S. Citizen)
    - Latin American (Non-U.S. Citizen)
    - Native American
    - Other, please specify:

6. What country (or countries) do you hold a citizenship?
7. What is your native country?
8. Number of years living in your native country
9. Number of years living outside your native country

10 Number of years living in the U.S.

11. What is your native culture? (Ex. African American, Asian American, Brazilian, Japanese, Mexican, North American)

12. What is your native language? (Ex. Chinese, English, and Spanish)
13. Have you ever used a hammer? __Yes __No
14. Have you ever used a handsaw? __Yes __No
15. Have you ever used a power drill? __Yes __No
16. Have you ever worked (full-time or part-time) as a construction worker (ex. painter, carpenter)? __Yes __No

    If yes, please specify number of months you work(ed) as a construction worker.

Section 2: Acculturation Questions

Please select the answer that best matches your response to each statement by using the rating scale below:

1=False 2=Partly false 3=Partly True 4=True

For questions that refer to "native country," "native culture," or “native language,” please refers to the answers you specified above.

1. I understand English but I'm not fluent in English.
2. I am informed about current affairs in the United States.
3. I speak my native language with my friends and acquaintances from my native country.
4. I have never learned to speak the language of my native country.
5. I feel totally comfortable with Caucasian American people.
6. I eat traditional foods from my native culture.
7. I have many Caucasian American acquaintances.
8. I feel comfortable speaking my native language.
9. I am informed about current affairs in my native country.
10. I know how to read and write in my native language.
11. I feel at home in the United States.
12. I attend social functions with people from my native country.
13. I feel accepted by Caucasian Americans.
14. I speak my native language at home.
15. I regularly read magazines (either hard copy or electronic copy) of my ethnic group.
16. I know how to speak my native language.

17. I know how to prepare Caucasian American foods.
18. I am familiar with the history of my native country.
19.I regularly read an American newspaper.
20. I like to listen to music of my ethic group.
21. I like to speak my native language.
22. I feel comfortable speaking English.
23. I speak English at home.
24. I speak my native language with my spouse or partner.
25. When I pray, I use my native language.
26. I attend social functions with Caucasian American people.
27. I think in my native language.
28. I stay in close contact with family members and relatives in my native country.
29. I am familiar with important people in American history.
30. I think in English.
31. I speak English with my spouse or partner.
32. I like to eat American foods.

Appendix D: Percentage of women in the construction industry

Country	Year									
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
North America										
United States	**9.94**	**10.02**	**9.44**	**9.37**	**9.86**	**9.68**	**9.75**	**9.28**	**9.62**	**9.67**
Asia										
Hong Kong	5.23	5.75	5.71	6.07	6.59	6.33	7.07	7.57	7.71	7.53
Indonesia	2.68	3.16	3.57	3.86	3.51	N/A	N/A	N/A	N/A	N/A
Japan	15.99	15.97	16.35	16.16	15.53	15.01	15.19	14.89	0.83	0.68
Malaysia	6.53	6.74	6.34	6.10	6.25	6.12	7.32	7.21	7.00	N/A
Philippines	1.53	1.34	2.13	2.05	1.29	1.89	1.97	2.08	1.95	1.64
Singapore	10.65	14.17	13.80	14.85	15.46	6.02	15.93	14.27	17.47	N/A
South Korea	9.61	10.15	10.83	9.06	8.27	8.48	8.58	8.59	8.15	8.90
Thailand	17.28	19.97	20.97	15.40	17.18	14.88	13.91	14.57	14.31	15.07
Vietnam	N/A	10.17	10.45	10.30	10.04	9.32	9.81	8.96	9.17	9.33
Average	**8.69**	**9.71**	**10.02**	**9.32**	**9.35**	**8.51**	**9.71**	**9.77**	**8.32**	**7.19**
Latin America										
Argentina	3.05	2.32	1.75	1.83	2.41	3.04	2.11	2.11	2.20	N/A
Belize	2.62	4.00	3.78	1.30	3.06	N/A	N/A	N/A	N/A	N/A
Bolivia	1.97	1.70	3.09	N/A	0.96	3.84	N/A	N/A	N/A	N/A
Brazil	2.46	2.40	2.14	3.88	3.90	N/A	2.66	2.64	2.34	N/A
Chile	3.47	3.45	3.01	3.10	3.04	2.19	2.83	3.11	3.81	3.57
Colombia	6.08	5.87	6.91	7.43	9.42	4.41	4.02	4.30	4.14	3.96
Costa Rica	1.60	1.24	1.76	1.23	1.26	2.50	3.57	1.93	1.24	2.15
Ecuador	2.86	4.24	3.47	2.62	4.73	3.46	3.07	6.03	N/A	3.54
El Salvador	2.54	3.03	2.88	2.72	3.44	1.43	2.48	3.74	2.09	3.01
Guyana	N/A	N/A	25.24	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Honduras	0.98	1.99	1.81	1.63	2.97	N/A	N/A	N/A	N/A	1.81
Mexico	2.76	2.55	3.09	3.16	1.94	2.60	2.75	2.76	2.01	3.22
Panama	1.55	2.47	3.32	2.30	3.49	3.45	4.20	4.06	3.87	1.98
Peru	N/A	2.31	4.65	1.55	2.17	4.04	2.17	1.84	1.27	1.01
Uruguay	2.19	N/A	N/A	2.06	2.43	2.10	2.28	2.07	1.87	N/A
Venezuela	3.92	3.20	3.80	3.89	3.65	3.97	3.63	3.96	N/A	N/A
Average	**2.66**	**2.88**	**4.64**	**3.02**	**3.23**	**3.09**	**2.98**	**3.21**	**2.48**	**2.69**

Note: N/A = Not available

Table D.1: Percentage of women employed by the construction industry [d]ILO (2006).

Appendix E: Informed Consent Form

Informed Consent for Participants for Research Projects Involving Human Subjects
Grado Department of Industrial and System Engineering
Virginia Polytechnic Institute and State University

TITLE: An examination of construction behavior among Asians, Americans, and Latin Americans

STUDENT RESEARCHER: Sasima Thongsamak

FACULTY ADVISOR: Dr. Brian M. Kleiner

PURPOSE OF THIS RESEARCH
The purpose of this research is to study construction behavior among Asians, Americans, and Latin Americans

PROCEDURE
You will be asked to complete two phases of this study. It will take you about 3 hours to complete the entire study.

Phase I: This contains screening and pre-experiment I questionnaires that ask you about your demographics, acculturation, risk perception and risk-taking behavior. These questionnaires are to be completed before you come to the research site to perform Phases II.

Phase II: You will be asked to come to the research site. Upon arriving, you will complete the pre-experiment II questionnaire that contains questions about locus of control, self-efficacy, and culture. Next, the researcher will train you on the task and safety issues. You will be asked to build three objects using a hammer, a handsaw, a power drill, nails, and screws. Next, you will be asked to complete the post experiment questionnaire. Then you will be interviewed by the researcher.

VIDEO RECORDING
Phase II of this study will be video recorded via webcams. These recordings are required to participate in this study.

RISKS OF PARTICIPATION
Accident and injury could happen while you are conducting the experiments. Your hands, fingers, eyes, and feet could be hurt. The tasks in this study are typical and similar to those that are done at home. If injury occurs, you should contact your medical provider for treatment. The research team does not provide and is not responsible for any medical treatments associated with injury resulting from this research. The research team is not

reliable for your injury or any medical costs associated with the injury. You are fully liable and responsible for all medical costs associated with injury resulting from this research.

BENEFIT OF THIS RESEARCH
This research will benefit the construction industry. It will help gain understanding of the behaviors of construction workers from different culture.

COMPENSATION
You will be compensated at $20.00-$30.00 depending on your performance. Three participants will receive $50, $30, or $10 cash for the top three performances for a selected task. There will be total of 36 participants, so you will have 1 in 12 chance of winning $50, $30, or $10 cash. Compensation will be given when the entire research session has been completed.

ANONYMITY AND CONFIDENTIALITY
After the data is collected, it will be identified by participant numbers. Your identity will remain anonymous and confidential. The only person that can identify you as a participant in this study is the researcher. Data in this study will not be confidential. The researcher will use this data in discussion, publication, or future research.

FREEDOM TO WITHDRAW
You are free to withdraw from this study at any time. If you do not complete the entire research session, you will be compensated at the rate of $5.50/hour for the time you participated.

APPROVAL OF RESEARCH
This research has been approved, as required by the Institutional Review Board (IRB) for projects involving human participants at Virginia Polytechnic Institute and State University and by the Grado Department of Industrial and Systems Engineering.

PARTICIPANT'S RESPONSIBILITY AND PERMISSION
I volunteer to participate in this study. I agree to answer all the questions as honestly as possible. I agree not to discuss any aspect and detail of this research to others until the researcher has informed me that I can do so. I have read this informed consent form and fully understand the process and the conditions of this research. I have had all my questions answered. I agree to abide by all the rules of this research. I understand that I may withdraw from the study at any time and will be compensated according to the time I spend on this study. I understand that the researchers do not provide any medical assistant and are not responsible and liable for any and all medical costs associated with the injury resulting from this research. I agree that I am responsible to seek for any medical treatments and liable for all costs related to any and all medical costs associated with injury resulting from this research. I hereby give my voluntary consent to be a participant in this research study.

____ ________________
Signature Date

____
Printed Name

Should you have any questions or concerns about this research or how it is conducted, you may contact:

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Appendix F: Pre-Experiment I Questionnaire

Please answer the following questions as honestly and as accurately as possible. Your participation is highly appreciated. Your answers will help us better understand and answer many questions about human behavior. If you have any questions, please do not hesitate to send an email to Sasima at ConstructionStudy@vt.edu.

Section 1: General Risk Perception

Name:

Using the scale below, please rate how risky you think each activity is:

1 = Not at all risky

2 = Slightly risky

3 = Moderately risky

4 = Very risky

5 = Extremely risky

1. Going sky-diving

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

2. Watching a welder work without wearing welders' glasses.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

3. Having sex with a partner that you have known for a very brief time.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

4. Exceeding the speed limit by 30 miles per hour (48 kilometers per hour) or more.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

5. Driving the wrong way on a one-way street.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

6. Passing when the solid yellow line is in your lane.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

7. Living in a house that has potential for high levels of radon.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

8. Living near a source of radioactive pollution.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

9. Changing a tire on a car without blocking a wheel.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

10. Pulling an electric plug out of the socket by the cord.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

11. Being a passenger in a small private plane.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

12. Using an electric power saw/tool without wearing safety glasses.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

13. Being in the outdoors, away from shelter during an electrical storm.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

14. Eating foods known to produce cholesterol in the body.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

15. Lifting a weight of 30 pounds (13.6 kilograms) or more from the floor.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

16. Exceeding the speed limit by 10 miles (16 kilometers) per hour.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

17. Jump start a car without wearing safety glasses.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

18. Not wearing your seatbelt while you are a passenger riding a distance of over 20 miles (32 kilometers).

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

19. Carrying 10 pounds (4.5 kilograms) up a ladder.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

20. Riding in bed of a pick-up truck.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

21. Going down a dark staircase.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

22. Riding a motorcycle without a helmet.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

Section 2: Construction Risk Perception and Risk-Taking Behavior

As you complete this section of the study, imagine yourself working at a construction site. If you have any questions, please do not hesitate to send an email to Sasima at ConstructionStudy@vt.edu.

Name:

Using the scale below, please rate how risky you think each activity is:

1 = Not at all risky

2 = Slightly risky

3 = Moderately risky

4 = Very risky

5 = Extremely risky

1. Not wearing a hard hat in an area where it is required.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

2. Not wearing safety glasses when there are flying particles.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

3. Not wearing ear plugs in a high level noise environment.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

4. Not wearing fall protection when there is an opening to a lower level of 9 feet (2.7 meters).

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

5. Not wearing steel toe shoes when anything might crush or penetrate your feet.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

6. Not wearing gloves when working with sharp tools

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

7. Lifting materials that are too heavy.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

8. Using improper tools for the job.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

9. Listening to a radio while working around moving vehicles.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

10. Working from a ladder that is set up incorrectly.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

11. Operating a machine without training.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

12. Not wearing a respirator in dusty environments.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

13. Tossing a nail gun to another person.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

14. Working at a faster pace to get work done earlier, even though you could injure yourself.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

15. Taking short cuts to get work done earlier, even though it may put you in danger.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

Using the scale below, please rate your likelihood of engaging in each activity:

1 = Very unlikely

2 = Unlikely

3 = Not sure

4 = Likely

5 = Very likely

1. Not wearing a hard hat in an area where it is required.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

2. Not wearing safety glasses when there are flying particles.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

3. Not wearing ear plugs in a high level noise environment.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

4. Not wearing fall protection when there is an opening to a lower level of 9 feet (2.7 meters).

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

5. Not wearing steel toe shoes when anything might crush or penetrate your feet.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

6. Not wearing gloves when working with sharp tools.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

7. Lifting materials that are too heavy.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

8. Using improper tools for the job.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

9. Listening to a radio while working around moving vehicles.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

10. Working from a ladder that is set up incorrectly.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

11. Operating a machine without training.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

12. Not wearing a respirator in dusty environments.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

13. Tossing a nail gun to another person.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

14. Working at a faster pace to get work done earlier, even though you could injure yourself.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

15.Taking short cuts to get work done earlier, even though it may put you in danger.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

Appendix G: Pre-Experiment II Questionnaire

Subject No.____________

Please indicate your degree of agreement with the following statements. Your answers will help us better understand and answer many questions about human behavior.

Section 1: Locus of Control

Statements	Strongly Disagree	Disagree	Tend to Disagree	Tend to Agree	Agree	Strongly Agree
1. Occupational accidents and injuries occur because employees do not take enough interest in safety.	1	2	3	4	5	6
2. Most accidents are unavoidable.	1	2	3	4	5	6
3. Whether I get injured or not is a matter of fate, chance or luck.	1	2	3	4	5	6
4. No matter how hard I try to prevent them, there will always be on-the-job accidents.	1	2	3	4	5	6
5. It is the company's responsibility to prevent all accidents at work.	1	2	3	4	5	6
6. Most accidents at work are due to employees' carelessness.	1	2	3	4	5	6
7. If I follow all company rules and regulations, I can avoid many on-the-job accidents.	1	2	3	4	5	6
8. Most accidents that result in injuries to employees are largely preventable.	1	2	3	4	5	6
9. I feel like what happens in my life is mostly determined by powerful people.	1	2	3	4	5	6
10. When I make plans, I am almost certain to make them work.	1	2	3	4	5	6
11. I have often found that what is going to happen will happen.	1	2	3	4	5	6
12. Getting what I want requires pleasing those people above me.	1	2	3	4	5	6
13. I can pretty much determine what will happen in my life.	1	2	3	4	5	6
14. When I get what I want, it's usually because	1	2	3	4	5	6

Statements	Strongly Disagree	Disagree	Tend to Disagree	Tend to Agree	Agree	Strongly Agree
I worked hard for it.						
15. My life is determined by my own actions.	1	2	3	4	5	6
16. It's not always wise for me to plan too far ahead because many things turn out to be a matter of good or bad fortune.	1	2	3	4	5	6

Section 2: Self-Efficacy

Statements	Strongly Disagree	Disagree	Tend to Disagree	Tend to Agree	Agree	Strongly Agree
1. If I can't do a job the first time, I keep trying until I can.	1	2	3	4	5	6
2. I avoid facing difficulties.	1	2	3	4	5	6
3. If something looks too complicated, I will not even bother to try it.	1	2	3	4	5	6
4. When I decide to do something, I go right to work on it.	1	2	3	4	5	6
5. Failure just makes me try harder.	1	2	3	4	5	6
6. I feel insecure about my ability to do things.	1	2	3	4	5	6
7. I do not seem capable of dealing with most problems that come up in life.	1	2	3	4	5	6
8. One of my problems is that I cannot get down to work when I should.	1	2	3	4	5	6
9. When I have something unpleasant to do, I stick to it until I finish it.	1	2	3	4	5	6
10. When unexpected problems occur, I don't handle them well.	1	2	3	4	5	6

Section 3: Culture

For Questions 1-8 of this section, please think of an ideal job, disregarding your present job if you have one. In choosing an ideal job, how important would it be to you to…

Questions	Of utmost importance	Very important	Of moderate importance	Of little importance	Of very little or no importance
1. Have sufficient time left for your personal or family life.	1	2	3	4	5
2. Have good physical working conditions (good ventilation and lighting, adequate work space, etc.).	1	2	3	4	5
3. Have a good working relationship with your direct superior.	1	2	3	4	5
4. Have security of employment.	1	2	3	4	5
5. Work with people who cooperate well with one another.	1	2	3	4	5
6. Be consulted by your direct superior in his/her decisions.	1	2	3	4	5
7. Have an opportunity for advancement to higher level jobs.	1	2	3	4	5
8. Have an element of variety and adventure in jobs.	1	2	3	4	5

For Questions 9-12, in your private life, how important is each of the following to you?

Questions	Of utmost importance	Very important	Of moderate importance	Of little importance	Of very little or no importance
9. Personal steadiness and stability	1	2	3	4	5
10. Thrift (wise economy, saving)	1	2	3	4	5
11. Persistence (determination)	1	2	3	4	5
12. Respect for tradition	1	2	3	4	5

13. How often do you feel nervous or tense at work?

1 = never

2 = seldom

3 = sometimes

4 = usually

5 = always

14. In your home country, how frequently in your experience, are subordinates afraid to express disagreement with their superiors?

1 = very seldom

2 = seldom

3 = sometimes

4 = frequently

5 = very frequently

For questions 15-20, how much do you agree or disagree with each of the following statements?

Questions	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
15. Most people can be trusted.	1	2	3	4	5
16. One can be a good manager without having precise answers to most questions that subordinates may raise about their work.	1	2	3	4	5
17. An organization structure in which certain subordinates have two bosses should be avoided at all cost.	1	2	3	4	5
18. Competition between employees usually does more harm than good.	1	2	3	4	5
19. A company’s or an organization’s rules should not be broken- not even when the employee thinks it is in the company’s best interest.	1	2	3	4	5
20. When people have failed in life it is often their own fault.	1	2	3	4	5

Appendix H: Safety Training

The safety training has been taken from various sources. The purpose of this training is to ensure the participants awareness of safety in performing the experimental tasks. The safety training is presented below (Armstrong, 1980; [a]Baker, Downey, Gross, & Reiter, 1994; [b]Baker, Downey, Gross, & Reiter, 1994; [c]Baker, Downey, Gross, & Reiter, 1994; [d]Baker, Downey, Gross, & Reiter, 1994, Burke's Backyard, 2002; Canadian Centre for Occupational Health & Safety[CCOSH], 2006; Chao & Henshaw, 2002; Environmental Health and Safety, n.d.; Target Brands, 2005; the California Occupational Safety and Health Administration, the National Institute for Occupational Safety and Health, & Centers for Disease Control and Prevention [Cal/OSHA, NIOSH, & CDC], 2004):

General:

1. Use safety glasses or goggles when using a hammer, a handsaw, and a power drill to help protect you from flying particles ([d]Baker, Downey, Gross, & Reiter, 1994).
2. Wear gloves to protect you from cuts, splinters, and burns ([d]Baker, Downey, Gross, & Reiter, 1994).
3. Wear ear plugs or ear muffs if your work creates a lot of noise ([c]Baker, Downey, Gross, & Reiter, 1994).
4. Inspect the tools every time before you use them. Never use a hammer with a loose or damaged handle. Check the handsaw for sharpness, chips, wear, and metal fatigue. Do not use tools that are not in good shape ([a]Baker, Downey, Gross, & Reiter, 1994; CCOSH, 2006).
5. You should not take your eyes off of the object that you are working on.
6. Do not carry nails, screws, or sharp tools in your pocket (CCOSH, 2006) or your mouth.
7. Do not wear loose clothing or jewelry. Cover or tie up long hair (Target Brands, 2005).
8. Avoid working in awkward postures and make sure you have enough space to work and can keep your body at a comfortable angle to the work. Avoid raising

your shoulders and elbows while performing a task. Adjust the position of the tool, or the orientation of the work surface to minimize bending your wrist or body, reaching, or twisting ([b]Baker et al., 1994; Cal/OSHA et al., 2004).

Hammer:

9. When using a hammer, strike directly and squarely over the surface, avoiding glancing blows, as well as over and under strikes (CCOSH, 2006).
10. When using a hammer, do not strike the object with the side of the hammer (CCOSH, 2006).
11. Use a power grip to hold a hammer while working on a task (Cal/OSHA, NIOSH, & CDC, 2004).
12. To hammer in a nail, first hold the nail in position. Rest the hammer on the nail so that the center of the hammer is at the center of the nail head. Tap lightly with the hammer so that the nail can start to go into the wood. Then remove your hand from holding the nail. Keep an eye on the nail head and hit the nail in with a swinging action from the elbow to the shoulder (Burke's Backyard, 2002).

Handsaw:

13. Do not carry a saw by the blade.
14. Before cutting wood with a handsaw, check the wood for nails, knots, and other objects that may damage the saw. Use the clamp to help hold the object. Start the cut carefully and slowly to prevent the blade from jumping. Pull upward until the blade catches the wood. Start with a partial cut, and then set the saw at the proper angle. Apply pressure on the down stroke only (CCOSH, 2006).
15. When using a saw keep your hands and fingers away from the saw blade.
16. Don't force the saw; let the cutting surface do the work ([b]Baker, Downey, Gross, & Reiter, 1994).
17. Put the safety guard back once you have finished using the saw.

Power Drill:

18. Check the drill for damaged parts. Before using the drill, any part that is damaged should be carefully checked to determine that it will operate properly and perform its intended function. Check for alignment of moving parts, binding of moving parts, breakage of parts, mountings, and other conditions that may affect its operation. Check the bits to make sure they are sharp and not chipped. Inspect screws and tighten any ones that are loose. Don't use the tool if the switch does not turn on and off properly (Target Brands, 2005).
19. Do not force the drill. It will do the job better and more safely at the rate for which it was intended (Target Brands, 2005).
20. Do not touch the drill bit with your hands after drilling. The bit can become extremely hot after the job is completed (Target Brands, 2005).
21. Secure your work. Use clamps to hold the work if possible. It's safer than using your hands and it frees both of your hands to operate the tool (Target Brands, 2005).
22. Avoid unintentional starting. Don't carry the drill with a finger on the switch. Be sure the direction switch is in the neutral position when the drill is not in use or when you are changing bits (Target Brands, 2005).
23. Do not use the drill power to tighten or loosen the chuck. The bit can fly off or your hand might get caught by the bit.
24. Use the magnetic guide drive to help you drive a screw. This will help prevent screws from flying.

Appendix I: Training Task

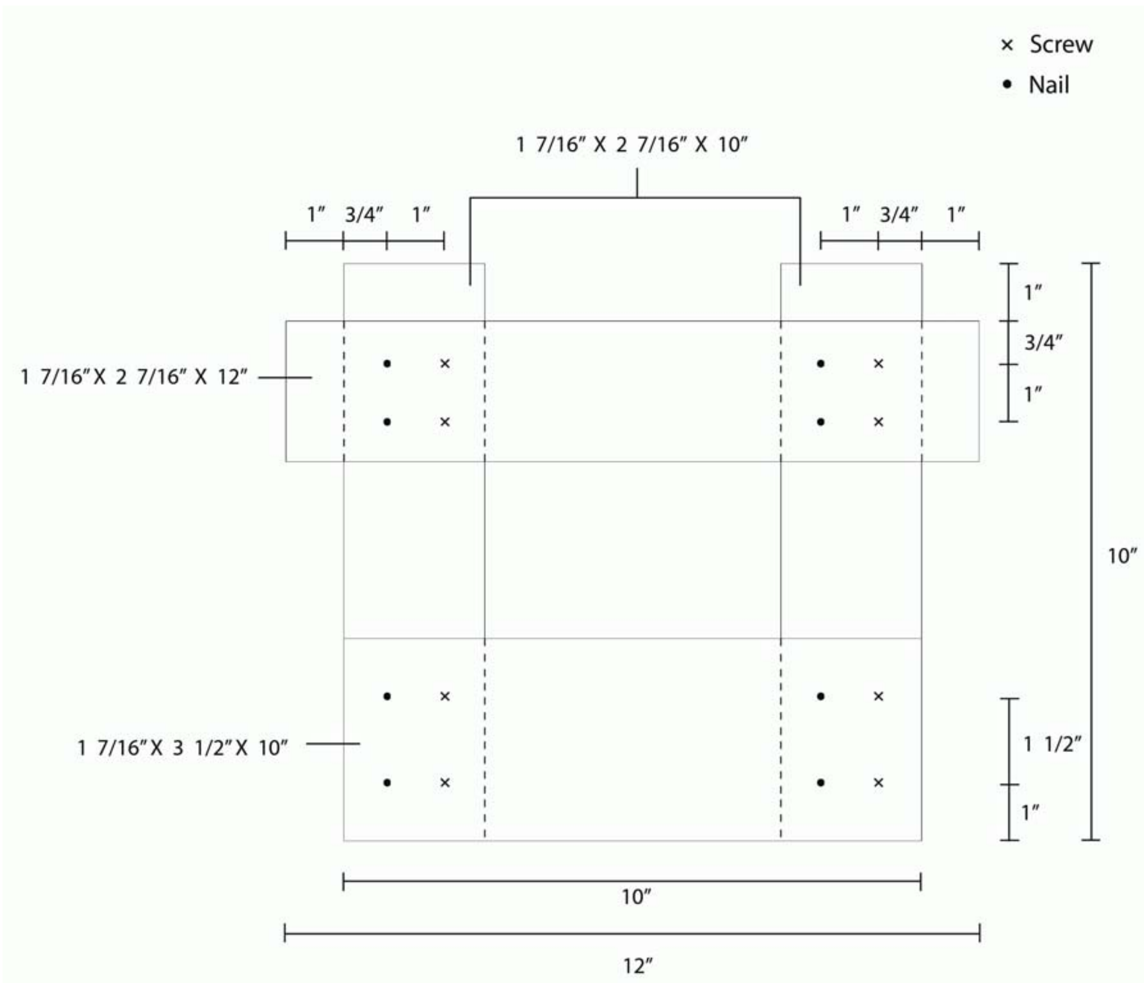

Figure I.1: Training task diagram.

Appendix J: Experiment Protocol

Check list

(1) Make sure the participant does not wear open-toed shoes.
(2) Make sure the participant does not wear loose clothes and ties up long hair.
(3) Instruct the participants on how to use the magnetic drive guide to put in screws for their own safety.
(4) Show the participants how to use a power drill, saw, and hammer.
(5) When using the saw, make sure that the participants work at the end of the table.
(6) Point out where the equipment is located.
(7) Inform the participants about the rules.

Rules

These rules must be followed strictly:

(1) You have to finish putting all the screws in before putting in the nails.
(2) You can work with up to two screws that are side by side at a time. You have to finish both of them before you can start the next set. For the nails, you have to finish each nail before you can start on the next one.

Training task

For the training task, perform the task with the highest quality and as fast as you can. It is expected that you will use 20 minutes to complete this task. This time is given so that you can practice the method that you will use to build an object. Time to complete the task, percentage of connected pieces with the correct number of screws and nails, and quality of your work will be used to measure your performance. You should not have to use a calculator; the dimensions provided will be used to determine your performance. The qualities that I am looking for are:

- The object should be stable and look the same as in the picture.

- All the cut wood has to be as specified as in the picture with 1/16 inch tolerance. Measurements will be taken at the face where the pieces of the cut wood are not attached to another piece of wood.
- Corners and connections should be aligned.
- The positions of the screws and nails have to be as specified as in the picture with 1/16 inch tolerance.
- Nails and screws have to be in the right positions.

General Experiment Instruction

This is the start of the experimental part of this study. Payment setting and performance are independent from one task to another. These tasks simulate the work of a construction worker. Perform the task as if you were to work full-time under this payment setting. Make sure you follow the rules. You have to finish the task before you can claim that you are finished. I reserve the right to determine whether you have finished the task. There will be a little bit more work to build each object than what you did during the training task, so you want to take that into consideration when you pace yourself. You should not have to use a calculator, the dimensions provided will be used to determine your performance, meaning that your object will be evaluated based on the given dimensions.

Rewards

Perform the task with the highest quality and as fast as you can. The quality of your work, the percentage of connected pieces with the correct number of screws and nails, and the time taken to complete each task will be used to determine who will receive the rewards. The time allotted for each task is 20 minutes. If you go over this allotted time, for each minute over 20 minutes, 3 points will be deducted from your total score. If you finish the task before the 20 minutes is up, for each minute under 20 minutes, 3 points will be added to your score. Seconds will be rounded up to the nearest minute.

- The percentage of connected pieces with the correct number of screws and nails is worth 10 points.
- Stability is worth 10 points.

- Similarity to the picture is worth 20 points.
- Corners and connections are worth 16 points.
- Screws and nail positions are worth 32 points. 1 point will be deducted for each screw and nail that is off from the specified position with 1/16 tolerance.
- The correct number of screws and nails is worth 32 points. 1 point will be deducted for each screw and nail that is missing or misplaced.
- The precision of the cut wood is worth 20 points. 1 point will be deducted for each 1/16 of the cut wood that is off from the specified length with 1/16 tolerance. Measurements will be taken at the face where the pieces of the cut wood are not attached to another piece of wood.

You should not have to use a calculator; the dimensions provided will be used to determine your performance. First place will receive $50, second place will receive $30, and third place will receive $10.

Penalty

Perform the task with the highest quality and as fast as you can. You will have 20 minutes to complete this task. The maximum penalty is $10 which will be deducted from the $30 that you could have earned. The quality of your work, the percentage of connected pieces with the correct number of screws and nails, and the time taken to complete the task will be used to determine the penalty.

- The percentage of connected pieces with the correct number of screws and nails is worth 10 points.
- Stability is worth 10 points.
- Similarity to the picture is worth 20 points.
- Corners and connections are worth 16 points.
- For each point deducted, $0.25 will be deducted from your total payment.
- $0.25 will be deducted for each screw and nail that is off from the specified position with 1/16 tolerance.
- $0.25 will be deducted for each screw and nail that is missing or misplaced.

- $0.25 will be deducted for each 1/16 of the cut wood that is off from the specified length with 1/16 tolerance. Measurements will be taken at the face where the pieces of the cut wood are not attached to another piece of wood.

If you go over the allotted time, $2 will be deducted for each minute you go over. If you finish the task before the 20 minutes is up, for each minute under 20 minutes, $0.50 will be added back for each minute, only if you have money deducted from the penalty for the quality and the percentage of connected pieces. Seconds will be rounded up to the nearest minute.

No reward or penalty

Perform the task with the highest quality and as fast as you can. The expected finish time is 20 minutes. Your performance will be measured by the quality of your work, the percentage of connected pieces with the correct number of screws and nails, and the time taken to complete the task. There will be no reward or penalty associated with this task. The qualities that I am looking for are:

- The object should be stable and look the same as the object in the picture.
- All the cut wood must be as specified in the picture with 1/16 inch tolerance. Measurements will be taken at the face where the pieces of the cut wood are not attached to another piece of wood.
- Corners and connections should be aligned.
- The positions of the screws and nails have to be as specified in the picture with 1/16 inch tolerance.
- Nails and screws have to be in the right positions.

Appendix K: Performance Measurement

Your performance will be measured by using the following guidelines:

1. Time used to complete the tasks.
2. Percentage of connected pieces (with the correct number of screws and nails).
3. Quality
   - The objects should be stable and look the same as in the picture.
   - All the cut wood has to be as specified as in the picture with 1/16 inch tolerance. Measurements will be taken at the face where the pieces of the cut wood are not attached to another piece of wood.
   - Corners and connections should be aligned.
   - The positions of the screws and nails have to be as specified in the picture with 1/16 inch tolerance.
   - The number of the nails and screws that are in the correct positions.

Appendix L: Experimental Tasks

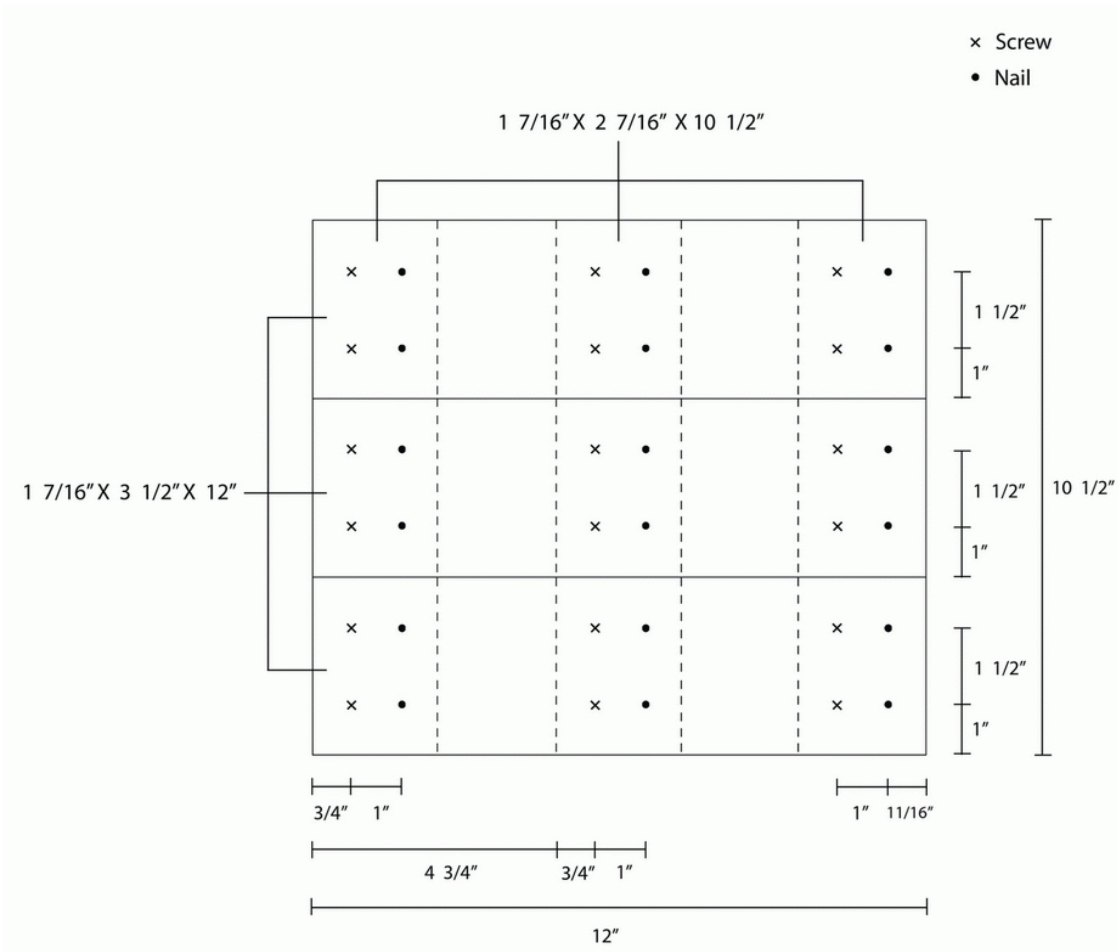

Figure L.1: Task A diagram.

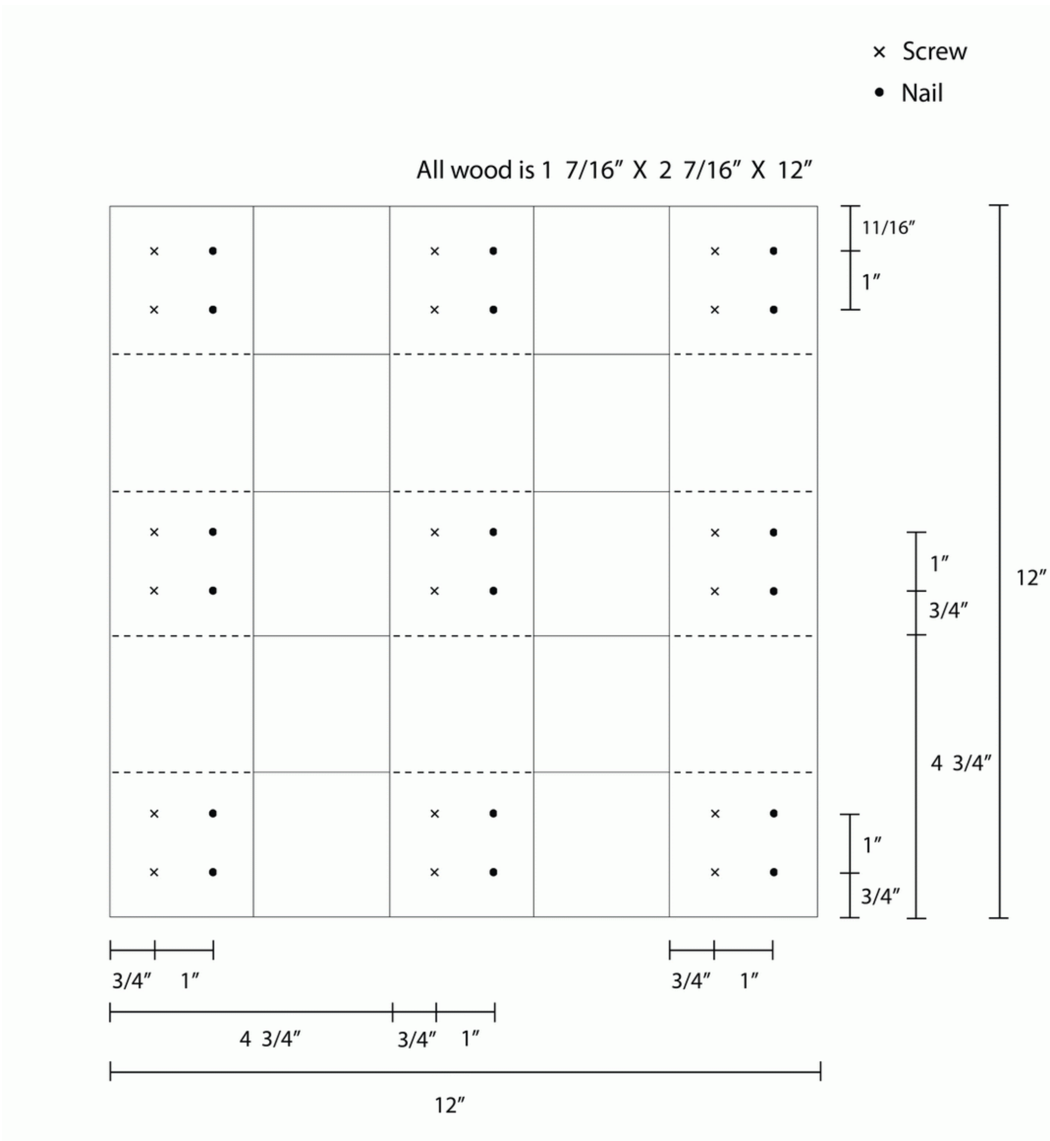

Figure L.2: Task B diagram.

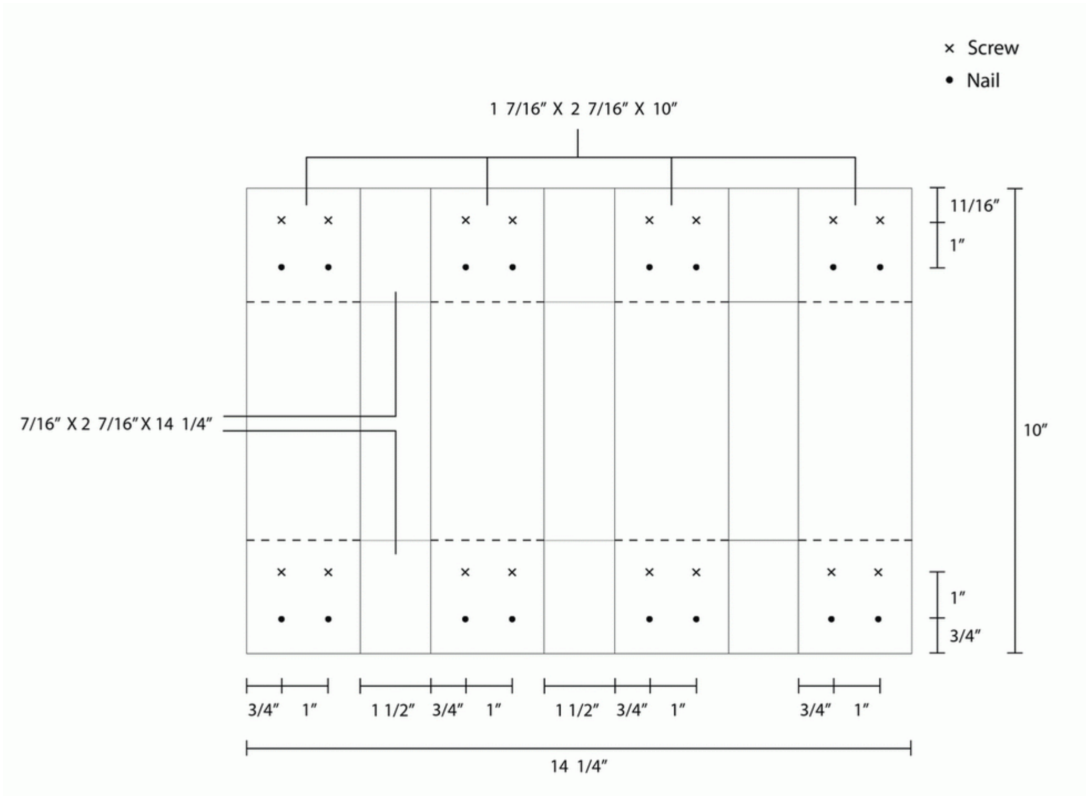

Figure L.3: Task C diagram.

Appendix M: Observation Sheet

Date:___________________________ Subject No: _____________

Risk-Taking Behaviors	Task and Reward		
	No. of time	No. of time	No. of time
Saw			
Does not wear safety glasses while cutting.			
Does not wear a glove on the hand that holds the saw.			
Does not wear a glove on the hand that holds the wood.			
Does not put the safety guard back after using the saw.			
Drill			
Does not wear safety glasses while drilling.			
Does not wear safety glasses while driving a screw.			
Does not wear a glove on the hand that holds the drill while drilling			
Does not wear a glove on the hand not holding the drill while drilling.			
Does not wear a glove on the hand that holds the drill while driving a screw.			
Does not wear a glove on the hand not holding the drill while driving a screw.			
Does not use a clamp to hold the wood while drilling.			
Does not use a clamp to hold the wood while driving a screw.			
Uses drill power to tighten the chuck.			
Hammer			
Does not wear safety glasses while hammering.			
Does not wear earplugs while hammering.			
Does not hold the hammer with a power grip while hammering.			
Holds nails by mouth.			
Does not hold the hammer at its handle.			

PERFORMANCE

Task and incentive combination:__________________ Subject No.:__________

Time taken to complete the task: _________________ minutes

Rewards

Performance Indicator	Deducted Points	Reward Full Score	Reward Points
Number of nails that are missing or misplaced		16	
Number of nails that are off from the specified positions.		16	
Number of screws that are missing or misplaced.		16	
Number of screws that are off from the specified positions.		16	
Wood 1		10	
Wood 2		10	
Stability		10	
Corners and connections		16	
Similarity		20	
Total-Quality			
Percentage of connected pieces		10	
Time		-	
Total	-		

Quality: 100 - _________________

Note: Stability____

____

Corners and connection____

____

Similarity____

____

PERFORMANCE

Task and incentive combination:__________________ Subject No.:__________

Time taken to complete the task: _________________ minutes

Penalty

Performance Indicator	Deducted Points	Penalty Full Score	Penalty Points
Number of nails that are missing or misplaced.		-	
Number of nails that are off from the specified positions.		-	
Number of screws that are missing or misplaced.		-	
Number of screws that are off from the specified positions.		-	
Wood 1		-	
Wood 2		-	
Stability		10	
Corners and connections		16	
Similarity to the picture		20	
Total-Quality			
Percentage of connected pieces		10	
Total	-		

Quality: 100 - _________________

Note: Stability____

____

Corners and connection____

____

Similarity____

____

PERFORMANCE

Task and incentive combination:__________________ Subject No.:__________

Time taken to complete the task: _________________ minutes

No reward or penalty

Performance Indicator	Deducted Points
Number of nails that are missing or misplaced.	
Number of nails that are off from the specified positions.	
Number of screws that are missing or misplaced.	
Number of screws that are off from the specified positions.	
Wood 1	
Wood 2	
Stability	
Corners and connections	
Similarity to the picture	
Total-Quality	
Percentage of connected pieces	

Quality: 100 - _________________

Note: Stability____

____

Corners and connection____

____

Similarity____

____

Appendix N: Post-Experiment Questionnaire

Subject No.________________

Section 1:

Please answer the following questions as honestly and as accurately as possible.

Statements	Poor	Fair	Good	Very good	Excellent
1. I think my performance (quality, percentage completed, and time) on the first task was:	1	2	3	4	5
2. I think my performance (quality, percentage completed, and time) on the second task was:	1	2	3	4	5
3. I think my performance (quality, percentage completed, and time) on the third task was:	1	2	3	4	5

4. I would rank my performance (quality, percentage completed, and time) from best to worst as:

   Best: Task #____________

   Medium: Task #__________

   Worst: Task #___________

   If two or three tasks are a tie, please specify:______________________

Please indicate your level of agreement with the following statements.	Strongly Disagree	Disagree	Tend to Disagree	Tend to Agree	Agree	Strongly Agree
5. I was in a rush to finish the first task.	1	2	3	4	5	6
6. I was in a rush to finish the second task.	1	2	3	4	5	6
7. I was in a rush to finish the third task.	1	2	3	4	5	6

8. I would rank my behavior from the most rushed to the least rushed as:

   The most rushed: Task #____________

   Medium rushed: Task #_____________

   The least rushed: Task #____________

   If two or three tasks are a tie, please specify:____________________

Please indicate your level of agreement with the following statements.	Strongly Disagree	Disagree	Tend to Disagree	Tend to Agree	Agree	Strongly Agree
9. I felt pressure to work fast on the first task.	1	2	3	4	5	6
10. I felt pressure to work fast on the second task.	1	2	3	4	5	6
11. I felt pressure to work fast on the third task.	1	2	3	4	5	6

12. I would rank the tasks that I felt pressured to work fast from highest to lowest as:

    The most pressure: Task #____________

    Medium pressure: Task #__________

    Lowest pressure: Task #___________

    If two or three tasks are a tie, please specify:____________________

Please indicate your level of agreement with the following statements.	Strongly Disagree	Disagree	Tend to Disagree	Tend to Agree	Agree	Strongly Agree
13. I was careful in terms of my own safety during the first task.	1	2	3	4	5	6
14. I was careful in terms of my own safety during the second task.	1	2	3	4	5	6
15. I was careful in terms of my own safety during the third task.	1	2	3	4	5	6

16. I would rank the tasks from which I was the most careful to the least careful in terms of my own safety as:

    The most careful: Task #____________

    Medium careful: Task #__________

    The least careful: Task #___________

    If two or three tasks are a tie, please specify:____________________

Please indicate your level of agreement with the following statements.	Strongly Disagree	Disagree	Tend to Disagree	Tend to Agree	Agree	Strongly Agree
17. I prefer working under the reward setting.	1	2	3	4	5	6
18. I prefer working under the penalty setting.	1	2	3	4	5	6
19. I prefer working under no reward and no penalty setting.	1	2	3	4	5	6

20. I would rank my preference in terms of payment setting (reward, penalty, and none) from the highest to lowest as:

    Highest preference: ____________

    Medium preference: ___________

    Lowest preference: ____________

    If two or three settings are a tie, please specify:____________________

Please indicate your level of agreement with the following statements.	Strongly Disagree	Disagree	Tend to Disagree	Tend to Agree	Agree	Strongly Agree
21. My motivation to work was high during the reward setting.	1	2	3	4	5	6
22. My motivation to work was high during the penalty setting.	1	2	3	4	5	6
23. My motivation to work was high during the no reward and no penalty setting.	1	2	3	4	5	6

24. I would rank my motivation to work under different payment setting (reward, penalty, and none) from the highest to lowest as:

    Highest motivation: ____________

    Medium motivation: __________

    Lowest motivation: ___________

    If two or three settings are a tie, please specify:____________________

Please indicate your level of agreement with the following statements	Strongly Disagree	Disagree	Tend to Disagree	Tend to Agree	Agree	Strongly Agree
25. The safety training was helpful in keeping me safe while working on the tasks.	1	2	3	4	5	6
26. The task training was helpful in performing the three experimental tasks.	1	2	3	4	5	6

Section 2: **Subject No.__________**

Please rate how risky you think each activity is if you were to engage in such activity. Each activity is listed under a tool used during the experiment.

Statements	Not at all Risky	Slightly Risky	Moderately Risky	Very Risky	Extremely Risky
Saw					
1. I don't wear safety glasses while cutting.	1	2	3	4	5
2. I don't wear a glove on the hand that holds the saw.	1	2	3	4	5
3. I don't wear a glove on the hand that holds the wood.	1	2	3	4	5
4. I don't put the safety guard back after using the saw.	1	2	3	4	5
Drill					
5. I don't wear safety glasses while drilling.	1	2	3	4	5
6. I don't wear safety glasses while driving a screw.	1	2	3	4	5
7. I don't wear a glove on the hand that holds the drill while drilling	1	2	3	4	5
8. I don't wear a glove on another hand while drilling.	1	2	3	4	5
9. I don't wear a glove on the hand that holds the drill while driving a screw.	1	2	3	4	5
10. I don't wear a glove on another hand while driving a screw.	1	2	3	4	5
11. I don't use a clamp to hold the wood while drilling.	1	2	3	4	5
12. I don't use a clamp to hold the wood while driving a screw.	1	2	3	4	5
13. I use drill power to tighten the chuck.	1	2	3	4	5
Hammer					
14. I don't wear safety glasses while hammering.	1	2	3	4	5
15. I don't wear earplugs while hammering.	1	2	3	4	5
16. I don't hold the hammer with a power grip while hammering.	1	2	3	4	5
17. I hold nails in my mouth.	1	2	3	4	5

Appendix O: Post-Experiment Interview Questions

Subject No:________________

Task and Reward Combination:________________

1. What do you think contributed to the differences in your overall performance? If there was no difference, why do you think there was no difference in your overall performance?
2. Why were you in a rush on some tasks and not on others? If you were not rushed, why weren't you in a rush on any of the tasks?
3. What do you think contributed to the differences in your feeling pressured to work fast? If there was no difference, why do you think there was no difference in your feeling pressured?
4. What do you think contributed to the differences of your behavior in terms of safety? If there was no difference, why do you think there was no difference in your behavior in terms of safety?
5. What do you think contributed to the differences in your motivation to work? If there was no difference, why do you think there was no difference in your motivation to work?
6. Do you feel that your culture accepts more risks than American culture?
7. Why didn't you wear personal protective equipment?
8. What do you think about the experiments (including the questionnaires and this interview)? Is there anything that should be changed or added?

Appendix P: Performance Evaluation

Deducted points:

- 1 point will be deducted for each screw and nail that is missing or misplaced.
- 1 point will be deducted for each screw and nail that is not in its specified position with 1/16" tolerance.
- 1 point will be deducted for each 1/16" of cut wood that is not cut to its specified length with 1/16" tolerance.
  - Each piece of wood will be measured at two places at both ends of the side that is not connected to the other pieces.
- 5 points will be deducted for each location (connection) on the object that is unstable.
- 1 point will be deducted for each connection that is not aligned within the 1/16" tolerance.
    - Each task contains 12 alignments between two pieces of wood.
    - For task A, the measurement of the position of the wood (at the center on the bottom) is worth 2 points each with a total of 2 measurements
    - For task B, the measurement of the position of the wood in the center is worth 1 point each with a total of 4 measurements.
    - For task C, the measurement of the position of the two pieces of wood in the middle is worth 1 point each with a total of 4 measurements.
- 1 point will be deducted based on the dissimilarity of your object to that in the picture.
    - 1 point will be deducted for 2 missing or misplaced nails and screws.
    - 1 point will be deducted for incorrectly placing the provided piece of wood.

Percentage of connected pieces:

% of connected pieces = (Number of pieces of wood that are connected together/ Number of pieces of wood required to complete the task)*100

Appendix Q: Cronbach's Alphas

General Risk Perception

General Risk Perception-Initial Cronbach's Alpha

Cronbach Coefficient Alpha

Variables	Alpha
Raw	0.886662
Standardized	0.887183

Cronbach Coefficient Alpha with Deleted Variable

	Raw Variables		Standardized Variables	
Deleted Variable	Correlation with Total	Alpha	Correlation with Total	Alpha
I1	0.113005	0.891784	0.116401	0.892391
I2	0.388102	0.884316	0.390858	0.884980
I3	0.421629	0.883598	0.423560	0.884074
I4	0.428099	0.883630	0.446816	0.883427
I5	0.547563	0.880338	0.548103	0.880581
I6	0.554109	0.880033	0.557603	0.880311
I7	0.405712	0.883931	0.412460	0.884382
I8	0.345685	0.885234	0.340176	0.886374
I9	0.649610	0.876644	0.645106	0.877810
I10	0.615892	0.877591	0.610562	0.878802
I11	0.384732	0.884751	0.376803	0.885368
I12	0.671829	0.876069	0.668487	0.877135
I13	0.689028	0.876935	0.692945	0.876427
I14	0.553396	0.879717	0.550017	0.880526
I15	0.328293	0.885909	0.323900	0.886819
I16	0.706162	0.877330	0.697374	0.876299
I17	0.641527	0.876917	0.636181	0.878067
I18	0.524504	0.880673	0.535425	0.880940
I19	0.184513	0.889039	0.184426	0.890585
I20	0.431209	0.883468	0.428015	0.883951
I21	0.614033	0.878558	0.609428	0.878834
I22	0.454718	0.882895	0.455475	0.883186

General Risk Perception-Final Cronbach's Alpha

Cronbach Coefficient Alpha

Variables	Alpha
Raw	0.893563
Standardized	0.896840

Cronbach Coefficient Alpha with Deleted Variable

	Raw Variables		Standardized Variables	
Deleted Variable	Correlation with Total	Alpha	Correlation with Total	Alpha
I2	0.410560	0.891781	0.411125	0.895690
I3	0.412052	0.892103	0.413873	0.895600
I4	0.482576	0.889958	0.503240	0.892635
I5	0.532044	0.888132	0.534107	0.891600
I6	0.609141	0.885616	0.616269	0.888815
I7	0.429626	0.891314	0.431675	0.895013
I9	0.645734	0.883767	0.639454	0.888021
I10	0.609827	0.885189	0.606505	0.889148
I12	0.671543	0.882871	0.669797	0.886977
I13	0.642682	0.884929	0.645885	0.887800
I14	0.511671	0.889081	0.506118	0.892539
I16	0.730735	0.883243	0.726382	0.885014
I17	0.630626	0.884355	0.627562	0.888428
I18	0.557978	0.887107	0.570106	0.890385
I20	0.433653	0.891653	0.432777	0.894977
I21	0.578759	0.886651	0.575068	0.890217
I22	0.444857	0.891545	0.440446	0.894723

Construction Risk Perception

Cronbach Coefficient Alpha

Variables	Alpha
Raw	0.936864
Standardized	0.938673

Cronbach Coefficient Alpha with Deleted Variable

	Raw Variables		Standardized Variables	
Deleted Variable	Correlation with Total	Alpha	Correlation with Total	Alpha
I1	0.760961	0.930648	0.758816	0.932706
I2	0.712209	0.931826	0.711073	0.933954
I3	0.837114	0.928082	0.837126	0.930635
I4	0.649140	0.933523	0.642961	0.935717
I5	0.736541	0.931226	0.732868	0.933386
I6	0.703914	0.932131	0.703570	0.934150
I7	0.704268	0.932103	0.707062	0.934059
I8	0.710246	0.931875	0.711495	0.933943
I9	0.503393	0.938854	0.505378	0.939215
I10	0.688450	0.932750	0.686570	0.934591
I11	0.699428	0.932731	0.701312	0.934208
I12	0.762177	0.930544	0.760908	0.932651
I13	0.521615	0.936441	0.528727	0.938627
I14	0.722209	0.931837	0.723971	0.933618
I15	0.599071	0.934702	0.603550	0.936728

Construction Risk-Taking Behavior

Cronbach Coefficient Alpha

Variables	Alpha
Raw	0.959745
Standardized	0.959872

Cronbach Coefficient Alpha with Deleted Variable

Deleted Variable	Raw Variables: Correlation with Total	Raw Variables: Alpha	Standardized Variables: Correlation with Total	Standardized Variables: Alpha
I1	0.761952	0.957084	0.757361	0.957321
I2	0.854941	0.955122	0.853658	0.955384
I3	0.669780	0.958830	0.669186	0.959068
I4	0.756317	0.957205	0.760096	0.957266
I5	0.798215	0.956358	0.795866	0.956550
I6	0.847808	0.955404	0.845823	0.955543
I7	0.771744	0.956934	0.776241	0.956944
I8	0.764325	0.957094	0.764958	0.957169
I9	0.639780	0.959482	0.644814	0.959547
I10	0.877573	0.954677	0.873780	0.954976
I11	0.782152	0.956675	0.776326	0.956942
I12	0.816157	0.956166	0.815003	0.956165
I13	0.826406	0.956027	0.822555	0.956013
I14	0.653808	0.959117	0.657153	0.959305
I15	0.695689	0.958344	0.698094	0.958498

Locus of Control

Internal Locus of Control-Initial Cronbach's Alpha

Cronbach Coefficient Alpha

Variables	Alpha
Raw	0.648662
Standardized	0.651752

Cronbach Coefficient Alpha with Deleted Variable

	Raw Variables		Standardized Variables	
Deleted Variable	Correlation with Total	Alpha	Correlation with Total	Alpha
I1	0.452404	0.589531	0.459802	0.589796
I6	0.033193	0.693631	0.071838	0.686955
I7	0.466479	0.582788	0.471405	0.586618
I8	0.189511	0.651013	0.187615	0.659761
I10	0.290020	0.629890	0.279663	0.637069
I13	0.369778	0.614834	0.372777	0.613116
I14	0.602784	0.549715	0.561063	0.561493
I15	0.397517	0.603337	0.385857	0.609669

Internal Locus of Control- Final Cronbach's Alpha

Cronbach Coefficient Alpha

Variables	Alpha
Raw	0.727777
Standardized	0.731398

Cronbach Coefficient Alpha with Deleted Variable

	Raw Variables		Standardized Variables	
Deleted Variable	Correlation with Total	Alpha	Correlation with Total	Alpha
I1	0.389537	0.709850	0.399299	0.713068

I7	0.345765	0.723386	0.339222	0.729745
I10	0.389017	0.709992	0.399340	0.713056
I13	0.549988	0.666072	0.547935	0.669613
I14	0.719834	0.616774	0.698255	0.622362
I15	0.432062	0.698547	0.432503	0.703634

External Locus of Control-Initial Cronbach's Alpha

Cronbach Coefficient Alpha

Variables	Alpha
Raw	0.314414
Standardized	0.353732

Cronbach Coefficient Alpha with Deleted Variable

	Raw Variables		Standardized Variables	
Deleted Variable	Correlation with Total	Alpha	Correlation with Total	Alpha
I2	0.022660	0.335103	0.022157	0.384633
I3	0.169882	0.259914	0.217935	0.284711
I4	0.239308	0.219915	0.250677	0.266827
I5	-.014275	0.386053	0.006020	0.392352
I9	0.414989	0.099455	0.428273	0.163635
I11	0.339336	0.197229	0.328013	0.223194
I12	0.236112	0.231129	0.223933	0.281460
I16	-.225883	0.465455	-.226681	0.495479

External Locus of Control-Final Cronbach's Alpha

Cronbach Coefficient Alpha

Variables	Alpha
Raw	0.581914
Standardized	0.577721

Cronbach Coefficient Alpha with Deleted Variable

	Raw Variables		Standardized Variables	
Deleted Variable	Correlation with Total	Alpha	Correlation with Total	Alpha
I3	0.413616	0.481293	0.415213	0.476553
I4	0.262460	0.571080	0.265744	0.560451
I9	0.433563	0.467953	0.440018	0.461832
I11	0.269232	0.561723	0.260795	0.563091
I12	0.325574	0.534239	0.303937	0.539783

Self-Efficacy

Self-Efficacy-Initial Cronbach's Alpha

Cronbach Coefficient Alpha

Variables	Alpha
Raw	0.737178
Standardized	0.748859

Cronbach Coefficient Alpha with Deleted Variable

	Raw Variables		Standardized Variables	
Deleted Variable	Correlation with Total	Alpha	Correlation with Total	Alpha
I1	0.431359	0.715384	0.439234	0.724128
I2	0.436578	0.710125	0.419517	0.727011
I3	0.354118	0.723206	0.365751	0.734771
I4	0.577418	0.688104	0.573214	0.704005
I5	0.717760	0.676041	0.735007	0.678429
I6	0.443530	0.708614	0.423157	0.726480
I7	0.156486	0.749523	0.173622	0.761317
I8	0.505602	0.697304	0.513788	0.713047
I9	0.100006	0.761240	0.110327	0.769668
I10	0.388004	0.718344	0.392575	0.730918

Self-Efficacy-Final Cronbach's Alpha

Cronbach Coefficient Alpha

Variables	Alpha
Raw	0.774421
Standardized	0.782916

Cronbach Coefficient Alpha with Deleted Variable

	Raw Variables		Standardized Variables	
Deleted Variable	Correlation with Total	Alpha	Correlation with Total	Alpha
I1	0.425648	0.760041	0.436770	0.767331
I2	0.490813	0.748688	0.470222	0.761908
I3	0.275208	0.785256	0.297795	0.789121
I4	0.584035	0.731479	0.580935	0.743459
I5	0.669932	0.724330	0.691280	0.724285
I6	0.440151	0.757101	0.418046	0.770335
I8	0.608461	0.724307	0.610616	0.738379
I10	0.398313	0.762237	0.404805	0.772447

Vita

Sasima Thongsamak, a daughter of Samphan and Jantra Thongsamak, grew up in Nakhon Si Thammarat, a mid-size town located on the coast of the gulf of Thailand. Sasima has two sisters, Laddawan Suannuch, Jutarat Thongsamak, and a brother, Supphat Thongsamak. Sasima graduated from Benjamarachuthit High School. She received a Bachelor of Science in Industrial Engineering from Chulalongkorn University in 2000, a Master of Science in Industrial and Systems Engineering from Virginia Tech in 2002, and a Doctoral of Philosophy in Industrial and Systems from Virginia Tech in 2007. Sasima worked as a graduate teaching assistant for the Grado Department of Industrial and Systems Engineering, and a graduate assistant at the Office of Distance Learning and Computing, College of Engineering throughout her graduate study.