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The interface among psychology, technology, and environment: Indigenous and cultural analysis of the probabilistic versus deterministic view of accident and safety

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This paper provides a comparative analysis of the probabilistic versus deterministic view of accident and safety using the indigenous and cultural perspectives. Death and injury due to accidents is the leading cause of preventable death in most countries, including Korea. The first part of this paper delineates the limitation of the linear, deterministic model that has been adopted in social and applied sciences. The transactional model, advocated by indigenous psychology, is provided to understand the probabilistic nature of accident and safety at home, in the workplace and in society. Second, factors related to accidents and safety are reviewed. Third, application of the probabilistic model for preventing accidents and promoting safety in Korea is outlined.

key words : accidents, safety, injury, deterministic view, probabilistic view, indigenous psychology, control, self-efficacy

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According to Baker, O'Neill, Ginsburg and Li (1992) accidental injury is the leading cause of death for children and adolescents in the USA. Children are more likely to die from injury than from all other diseases combined (Peterson & Gable, 1999). Around 75% of deaths for teenagers and young adults are caused by accidents. The leading cause of death due to injury is through traffic accidents (Baker, Fingerhut, Higgens, Chen & Braver, 1996). Every year, around 6,200 children and adolescents die and more than 1.4 million are injured from traffic accidents. The financial cost is estimated at $100 billion annually (Miller, Lestina, & Spicer, 1998). Similarly, death due to injury is the leading cause of death of children, adolescents and young adults in Korea, with majority of accidental death caused by traffic accidents (Han, in this issue).

In the workplace, industrial accidents are the second leading cause of preventable injury and death, second to traffic accidents. In 1996, 4,800 employed died in the USA and 3.9 million employees sustained injury causing one or more days of work stoppage (Hoffman & Stetzer, 1998). In terms of financial costs, the National Safety Council (1997) estimates that the loss due to work-related injuries and fatalities is estimated to be at $121 billion annually. In Korea, nearly 3,000 employees die each year and more than 70,000 employees miss more than four days of work or hospitalized due to industrial accidents (Park & Kim, 2001). In terms of economic costs, it is estimated that the overall economic loss is more than 600 billion won a year, which is more than twice as work stoppages due to labor unrest.

Although technological advances have significantly improved the safety devices at home, workplace, and society and new laws have been instituted to promote safety, the number and severity of accidents have not decreased in Korea in the recent years. The development of new technologies such as the anti-lock brakes and air bag in automobiles, coupled with better-maintained roads and lighting system have not reduced the overall traffic fatalities or injury in Korea and in other developed nations. In the workplace, computerization and mechanization of industries have reduced direct human contacts with heavy machines and hazardous chemicals, but accidental injury and death have not been significantly reduced (Park & Kim, 2001).

In economically developed nations, the workplace environment is now safer than ever before. Strasser, Aron and Bohn (1981) estimates that around 85% of the industrial accidents are caused by human factors. Recent analysis by Salminen and Talberg (1996) indicates that 84-96% of industrial accidents are caused by human factors. With scientific and technological advances, human factors are now the leading cause of industrial accidents. This is especially the case in Korea where computerization and mechanization have not reduced the overall rate and severity of industrial accidents. Thus, the psychological and cultural aspects remain as the key in reducing the overall rate of accidents and promoting safety in Korea

(Kim, Park, & Park, 1999).

The purpose of this paper is to review factors that contribute to our understanding of accidents and safety. In first part of this paper, a framework for understanding accidents and safety will be outlined. It will be pointed out that the traditional positivistic model in psychology is ill suited for unraveling the complexities of accidents and safety. The transaction model will be provided as an alternative framework for understanding the probabilistic nature of accidents and safety. In the second part of this paper, factors that contribute to accidents and safety will be reviewed. Finally, application of the probabilistic model for preventing accidents and promoting safety in Korea is outlined.

Accidents and Safety

The words accident and safety are related terms. Accidents can be defined as unintended consequences. Although positive consequences can results, such as accidental meeting or accidental discovery, it is usually associated with negative outcomes, such as death, injury, damage, harm or loss. Safety, in contrast, is the absence of unintended outcome. Safety refers to an absence of risk from experiencing danger, damage or injury. The concepts of safety have eluded systematic conceptualization, investigation and application since it is related to an absence of a negative event or reduction of perceived risks. Similarly, it is difficult to understand and prevent accidents since the consequence is not intended and usually unexpected. In other words, how can individuals and researchers deal with a situation when the outcome is a non-event (such as safety) and when it is unpredictable (such as accidents)?

Accidents can be avoided if we have control of our environment, others, and ourselves. Control can be defined as the ability to understand, predict and manage our environment (Bandura, 1997). In modern society, accidents occur not because our knowledge of our physical, biological, and mechanical world is limited, but because we have difficulties managing others and ourselves. In other words, the vast majority of accidents are caused by human factors and not by mechanical failures or natural disasters. The vast majority of injury and deaths caused by accidents that are preventable.

As pointed out above, the vast majority of accidents at home, school, work and society are caused by human factors. It is essential to understand the human factors that are responsible for accidents. Traditional approaches in psychology, however, are ill equipped to deal with accidents and safety since it has adopted the positivistic and linear approach. An alternative model, the transactional approach, is better suited to deal with the complex issues of accidents and safety.

Linear positivistic model

By emulating natural sciences, especially

Newtonian physics, experimental psychologists hoped to discover and amass universal laws of human behavior by adopting the linear positivistic approach (Kim, 1999, 2001; Koch & Leary, 1985). In the linear positivistic model, the goal is to discover universal laws of human behavior that transcend individual, social, cultural, temporal and historical boundaries (Sampson, 1978). They searched for basic elementary facts, which once discovered, could serve as building blocks for understanding complex human behavior. Experimental psychology hoped to develop a "periodic table" of human behavior, and laws that govern the formation of complex behavior. In this approach, subjective aspects such as meaning, intention, goals, and context were eliminated from the research design in order to discover abstract, universal and laws of human functioning.

In terms of causal explanation, experimental psychology adopted the linear positivistic model of causality. (See Figure 1). In this model, the goal of psychology is to discover the linear, causal, and objective relationship between an independent variable (Observable 1) and the dependent variable (Observable 2). Aspects that are not directly observable (e.g., meaning, intentions, and goals) or controllable (e.g., the natural context) are considered as "noise" and eliminated from the research design. Culture, as a context variable, was excluded from the research design. Experiments are conducted in a laboratory setting in which the context, independent variables, and dependent variables can be systematically controlled and measured. Psychological constructs (e.g., intention, goals, motivation, or emotions) are inferred as intervening variables.

This model represents a deterministic view of human behavior and searches for the basic underlying causal factors of human functioning. The goal is to discover one-to-one causal relationship between an independent variable and dependent variable. Once this basic causal relationship is discovered, it is used to analyze complex human behavior.

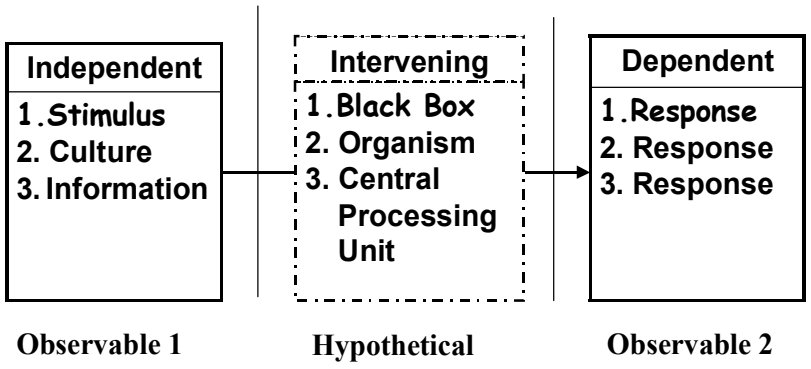

Figure 1. The linear model

Transactional model

In contrast to the linear model of human functioning, the transaction model focuses on the interactive, generative and integrative aspects of human functioning (Kim, 2001). In this model, espoused by Bandura (1997), the unobservable human qualities (e.g., intention, meaning, and goals) are not eliminated, but are central concepts that link a situation or event on the one hand and with behavior on the other. (See Figure 2).

In this model, it is important to examine how an individual perceives and interprets a particular event or situation (Causal linkage 1). This information can be obtained through self-report. The second step involves assessing individuals' performances (Causal linkage 2). For example, in a study of management effectiveness, Bandura (1997) systematically elevated or reduced participants' level of self-efficacy by providing them with a preset feedback of how well they performed relative to others. Self-efficacy is defined as "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (p. 3). He found that the positive feedback about their performance increased their self-efficacy and negative feedback decreased their self-efficacy (Causal linkage 1). In subsequent performance, those participants with elevated self-efficacy were more likely to use efficient analytical ability, to be satisfied with their level of performance, and to have higher performance levels (Causal linkage 2). The reverse was true for those participants who were given the negative feedback about their initial performance, which resulted in depressed levels of self-efficacy, and which was responsible for their poor performances. Thus, individuals' performance have been systematically elevated or depressed by providing feedback information that either increased or decreased their self-efficacy.

The pathway can be reversed. If the poor performing participants in Trial 1 are given positive feedback in Trial 2, self-efficacy was

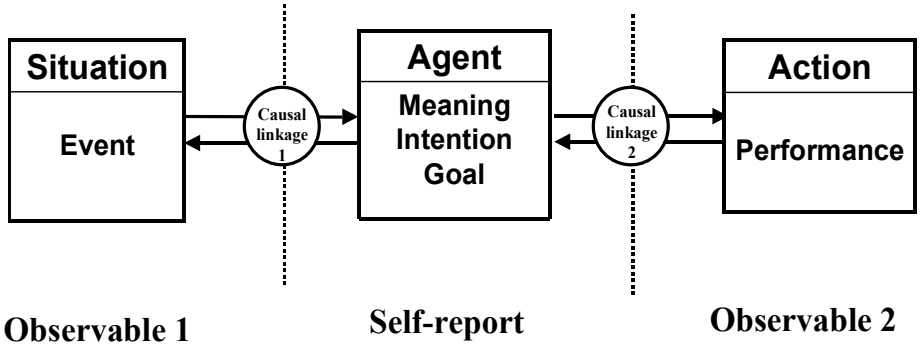

Figure 2. The transactional model

elevated and their performance improved. The reverse is true for those participants who did well in first trial. Whey they are subsequently given negative feedback, their self-efficacy decreased and their performance was poor. Thus, the rise or fall in self-efficacy can be systematically linked to the rise or fall in their performance in diverse areas of human functioning (Bandura, 1997)

In another study, Bandura, Reese and Adams (1982) were able to systematically increase self-efficacy of people with snake phobias. They had participants observe a model cope effectively with a snake. At this phase, self-efficacy belief of participants in handling the snake was assessed through self-report. They have found that watching a model coping effectively with the snakes increased participants' self-efficacy (Causal linkage 1). The second phase involved the subjects actually handling the snake. Those individuals with higher self-efficacy were more able to handle the snake (Causal linkage 2).

Successful performance of a task can reverse the flow of causality. The successful performance can increase self-efficacy, which in turn can motivate individuals to raise their goal or to seek more challenging goals. Opposite pattern of results is found for failure experiences, which lowered self-efficacy, and which in turn lowered the goal participants set for themselves. Successful mastery experiences could lead to *transformative* changes in other aspects of a person's life. For example, some individuals who have mastered their snake phobia were able to reduce their social timidity, increase their boldness, boost their self-expressiveness, and increase their desires to overcome other fears (e.g., the fear of public speaking). Bandura (1997) has found that mastery experience is the most effective way of increasing self-efficacy, followed by modeling and verbal persuasion.

At the group level, collective efficacy is defined as a “group's shared belief in its conjoint capabilities to organize and execute the courses of action required to produce given level of attainments” (Bandura, 1997, p. 477). The concept of self and collective efficacy is derived from socio-cognitive theory, which assumes that people are motivated to control their lives and environment to attain desirable goals and avoid undesirable consequences (Bandura, 1997). Control refers to our ability to understand, predict, and manage our environment and ourselves. According to Bandura, “the striving for control over life circumstances permeates almost everything people do throughout the life course because it provides innumerable personal and social benefits and "unless people believe that they can produce desired efforts by their actions, they have little incentive to act” (p. 1). Our efforts to create a safe home, school, workplace, and society can be understood as the desire to control our environment by reducing accidents that can cause injury, harm, or death

The method by which we can exert control over the environment can be direct or indirect and through the individual or others. (See Figure 3). Two types of direct control can be identified:

Locus	Individual	People
Direct	Primary	Collective
Indirect	Secondary	Proxy

Figure 3. Type of control

primary control and *collective control*. If a person exerts direct control over his or her environment to achieve a desired outcome, it is an example of primary control. If people work together in managing their environment, it is an example of collective control. Two types of indirect control can be identified: *secondary control* and *proxy control*. If a person obtains assistance from another person in managing one's environment, it is an example of proxy control. If a person accepts a given environment and regulates oneself to adapt to the environment, it is an example of secondary control.

Self-efficacy can be divided into four components: Belief, skill, performance and outcome. (See Figure 4). For example, a student can have a belief that one has the necessary skill to do well on a test. This belief will be confirmed or disconfirmed in an actual test (performance). The actual score on the test can determine whether or not one will enter a desired university and whether one will receive a scholarship (outcome). It is our performance on a given task that could determine the outcome. An outcome is probabilistic rather than determined, since a given performance may not always results in the same outcome, and since it is also dependent upon how well others do.

In this model, performance and outcome are not determined in a linear fashion, but dependent upon multiple factors. Individual behavior and the outcome of that behavior are probabilistic rather than determined. For example, in the USA and Korea, academic achievement does not depend only on possessing the necessary cognitive skills, but on multiple factors (e.g., self-regulatory skills, motivation, social support, and good relationship with parents, teachers, and friends; Bandura, 1997; Kim & Park, 1998; Kim & Park, 2003).

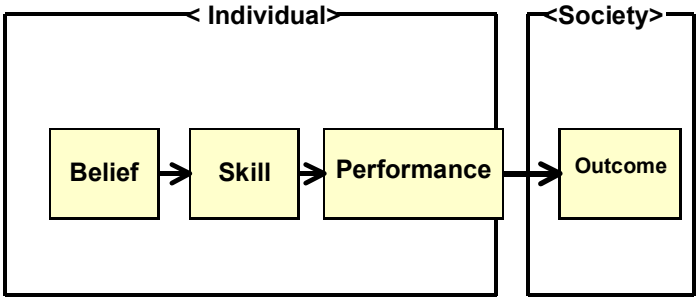

Figure 4. Self-efficacy

Similarly, entrance to a desired university has multiple determinants, with academic grade being just one component. In other words, behavior and outcome have multiple determinants and our understanding of human behavior and its outcome can be at best probabilistic.

Control, self-efficacy and safety

Safety involves analyzing the risks that lie in the natural, mechanical, and human world and managing them. Knowing the risks and probability does not ensure that individuals will engage in safe practices. For example, in Korea around 75% of Koreans report being afraid of being involved in an accident, especially traffic accidents (Han, in this issue). It is reported as the most serious social problem facing Korea (Han, Park, in this issue). Koreans also know that traffic accidents are caused by violating traffic laws (e.g., speeding, not observing the traffic signal, and drunk driving) and the number of people who are aware of this information has been increasing in the recent years (Lee, in this issue). In spite of this knowledge, the leading cause of traffic accidents and fatalities is speeding, not observing traffic signals, and drinking and driving (Choi, Han, Lee, in this issue). As a result, Korea has the highest rate of traffic mortality in the world, with 8.4 fatalities/ 10,000 automobiles in 1999 (Park & Kim, 2001).

In contrast, Japan has one of the lowest traffic fatalities rate in the world, with the rate of 1.2 fatalities/10,000 automobiles. In Japan, virtually everyone report following the traffic laws (98.1%), while 25% of Koreans report not following the traffic laws (Park & Kim, 2001). Similar results have been founded and reviewed in other studies (Choi, Han, Lee, in this issue). As for safe practices, the vast majority of Japanese (82.8%) report wearing a seat belt, whereas less than half of Koreans (48.6%) report wearing a seat belt (Park & Kim, 2001). Moreover, 65% of Koreans report violating the speed limit on a regular basis (Lee, in this issue). Although traffic accidents are much less likely in Japan, Japanese are more likely than Koreans to follow traffic laws and wear a seat belt. Koreans, on the other hand, are fearful of being involved in an accident and know that breaking traffic laws will increase the likelihood of being injured or dying, but they are more likely to break these laws. Although they know that there is high a high chance of being involved in an accident, many do not wear a seat belt.

The above results point to the limitation of the linear positivistic model that has been adopted in psychology. In other words, attitude, knowledge, and belief do not predict behavior in Korea. In other words, Koreans are fearful of being involved in an accident and realize that they are likely to involved in an accident, but they behave in a way that increases their chances being involved in an accident and being seriously injured by not wearing a seat belt. These results indicate that knowing and believing do not lead to behaving and acting in a linear fashion. There are other factors that mediate the relationship between

knowledge, attitude, and beliefs on the one hand and behavior on the other. The transactional model provides a framework for understanding the mediating role of control and efficacy.

In the area of the safety, primary control involves having the necessary knowledge, skills and resources to create a safe environment at home and in the workplace. Collective control involves establishing rules, regulations, institutions and laws and working together in collectively managing the environment. Proxy control involves obtaining the necessary assistance from others in managing one's environment. For example, children need the necessary socialization and education from their parents and teachers to avoid accidents and to engage in safe practices. Secondary control involves regulating oneself by developing the necessary knowledge, skill and lifestyle that promote safe practices. In order to create a safe environment, all four types of control need to be developed. Problems in safety occur when individuals or groups rely on one or two types of control and do not integrate the four types of control. In Korea, people focus on indirect control (i.e., secondary and proxy control) and neglect direct control (i.e., primary and collective control). This bias is responsible for the high rate of accidental injuries and deaths.

We cannot know in advance that a particular environment is absolutely safe and that a particular individual will not be involved in an accident. We know statistically that an individual will be involved in at least one traffic accident in one's lifetime. What we don't know is when, where and how. Although an individual cannot determine the outcome, one can reduce the probability that one will be involved in an accident and in case of an accident, one could reduce the injury caused by the accident. For example, driving defensively (e.g., drinking sober, being alert and driving within the speed limit) can decrease the probability of being involved in an accident. Wearing a seat belt and having an air bag can reduce the risk of injury if one is involved in an accident. Thus, safety involves reducing the probability of an accidents and not its elimination.

At the individual level, accident is binary in nature – either it occurs or it does not. Individuals experience an outcome and not probabilities. For example, when the weather forecast states that there is an 80% chance of raining, on any given day the outcome is binary – either it rains or it doesn't. However, over an extended period of time, 80% chance means that it will rains in four out of five cases. Probability is an analytical knowledge that must be deduced across individuals, over space and time. As such, it is difficult to convince a chain smoker to stop smoking by providing statistical probability that he will contract cancer. The fact that he does not have lung cancer at the moment, that he feels fine, and that he knows several individuals who had long and healthy lives can be used to reject the probabilistic data. When he actually contracts lung cancer, he may finally accept the fact, but

the post-hoc realization does not change the outcome. The outcome could have been changed only if he accepted the statistical probability and stopped smoking much earlier.

Understanding probabilities is an analytical knowledge that can be obtained through formal or public education. Analytical knowledge (e.g., grammar) is different from practical and episodic knowledge (i.e., knowing how to speak a language). Although a person can speak a language fluently, she may not have the analytic ability to analyze the grammar of her spoken words. The task of psychologists is to translate the experiential and episodic knowledge into analytical and probabilistic knowledge. Once this information is understood, then the next step is to translate this analytical and probabilistic information into concrete procedural and practical skills at the individual level. For example, we know that speeding, drinking and driving will increase the chances of being involved in an accident and this information represents an accumulation of many individual experiences across time and space. The second step involves using the analytical information and translating it into procedural skills so that an individual will engage in safe practices.

Promoting safe practices through individual, proxy and collective control

As pointed out above, safety involves analyzing the risks that lie in the natural, mechanical, and human world and managing these risks. Knowing the risks and probability is the first step, but it does not ensure that individuals will engage in safe practices. The second step involves managing these risks by educating the general public about these risks and then teaching them the necessary skills in managing these risks. This is especially important for children, since they do not possess the necessary knowledge and skills. As a result, they become victims to accidental injury and fatality. Children in Europe, USA, and Korea are most at risk in being involved in a pedestrian accident (Assailly, 1997; Park & Kim, 2001; Preusser & Blomberg, 1984). Although all children are taught the basic mechanics of crossing an intersection (e.g., looking in both directions, crossing the road without running, and raising a hand so that one is visible), many children fail to cross a street safely.

Thomson (1991, 1997) has found that children have misconceptions about locations that are safe to cross and how to act when they encounter dangerous situations. In their study, children between the age of 5 and 11 were asked to chart the safest possible route between two specified locations near their schools. Then the children guided the researchers through the safest route and giving their rationale. They have found that 75% of the older children constructed safe routes, while only 10% of the young children chose the safe routes.

According to Thomsen (1991, 1997), the younger

children chose the most direct route as being the safest, often crossing an intersection diagonally. They did not realize that they were putting themselves in danger from both sides of the road. They focused on spending the minimum amount of time spent on the road to reduce danger, rather than reducing the risk involved. They also deemed a street safe if they did not see any cars in the vicinity. If there were cars, and even if they were in a distance or traveling in the opposite direction, they deemed the street dangerous. In contrast, when the road is curbed, obstructed and the visibility is limited, younger children perceived the crossing of the road safe since they did not see any car. They fail to realize that the road that is curbed or obstructed is especially dangerous since cars are not visible to the children and since the child is not visible to the driver. Not until the age of 9 children realize this danger (Demetre, 1997). As a result, young children are more likely to be involved in traffic accidents since they attempt to cross road near a parked vehicle, which obstruct their view and view of the driver (Demetre, 1997).

Thomsen (1997) has found that informational training and classroom simulation had little effect since the younger children had difficulty understanding the rationale for avoiding obstructed areas and in constructing safe routes. The most effective training is practical training that occurs in the natural context. When the children were provide six 30-minutes training about the danger posed by "(1) obstructions limiting their view of the road; (2) intersections where relatively complex traffic movement might take place; and (3) the risks involved in meandering across the road", up to 70% of the 5 year old children learned to chose safe routes (p. 274). In contrast, children in the control group did not show any improvement. Although there was a deterioration of performance in the eight-month follow-up, the 5 year-old children who received training were performing at the 9 year-old levels.

When children were trained in groups of five children or by a model, they also benefited from the training (Thomsen, 1997). Although the level of improvement for groups was significantly less at 36%, the effect lasted longer with virtually no deterioration two-month later. The benefit of group training is that it saves time and resources and the effect last longer. Direct, individualized training (i.e., primary control) is the most effective way to promoting children's safe practices.

Thomsen (1997) points out that although individualized training is effective, schools and communities do not have the necessary time and resource to provide such an intensive and practical training. The most practical solution is to involve parents in providing the necessary training to their children. However, most parents lack the analytical skill necessary to chart the safest route. Also, when parents engage in unsafe behavior and children model their behavior. In analyzing injuries to children and adolescents involved in an accident, Miller et al. (1998) has found that the presence of an adult not wearing a seatbelt

increased the likelihood that children and adolescents were not wearing a seatbelt. When Thomsen (1997) trained the parents with the necessary skills and parents in turn provided the training to their children, they saw marked improvements in the children. Parents were just as effective as experts in promoting safe practices in their children. In other words, proxy control was as effective as primary control in promoting children's safe practices.

At the collective level, parent/child training programs have been developed and provided through kindergarten, primary schools and civic groups in the Netherlands and such programs resulted in positive outcomes (Rothengatter, 1981, 1984). Once the safest routes are created, structural changes in the community, such as additional street signs, crosswalks, and traffic lights, also help to reduce the number of traffic accidents involving young children. Thomsen (1997) points out that when parent, teachers, community members and experts are involved in analyzing, creating, and implementing safety procedures, the young children, who are most vulnerable to accidents, benefit the most from such a systematic program. In other words, collective control is also a necessary ingredient in reducing accidents and promoting safe practices. In conclusion, accidents can be prevented and safety can be promoted even for the most vulnerable members of our society by approaching safety in a systematic and integrated fashion.

Multiple determinants and contingencies

As point out above, a concerted and systematic effort at the individual, relational and collective level can reduce the risk of accidents and promote safe practices. In order to be effective, safety practices must become a part of lifestyle for all individuals in any given society. For example, immunization, which has been implemented at all three levels around the world, can be described as the most effective preventive program for controlling disease. Smallpox, which has killed millions of people for thousands of years, is now under control and it is now virtually eradicated.

Traffic accident is the leading cause of preventable injury and death for young children and adolescents. Industrial accidents are the second leading of preventable injury and death among adults, second only to traffic accidents. In contrast to immunization, accidental injury and death are difficult to prevent since it has multiple determinants and contingencies. A virus causes diseases and inoculation is a safe, simple and effective means of prevention. Accidents, in contrast, have multiple determinant and contingencies. In other words, preventing accident is not as simple as being inoculated.

In developed countries, such as the USA and Western Europe, accidental injuries and death have been significantly reduced in the recent years. They have been reduced through concerted efforts of individual citizens, concerned parents,

schools, civic organizations, and governmental agencies. However, there are some industries that fail to promote safe practices and continue to experience a high rate of accidental injury and mortality.

According to Pollnac, Poggie, and van Dusen (1995), the fishing industry in the USA has the worst safety record in the USA, with fatality rate being seven times higher than the national average. Fishermen in the USA are likely to be experience accidental injury and death when compared to their counterparts in Canada and Norway. Although this problem has been known for many years, fishermen in the USA tend to trivialize this information and fail to take the necessary safety precautions. Pollnac et al. (1995) have found many reasons for the high rate of accidental and fatality among the fishermen in the New England area. They have found that many fishermen cope with the situation by trivializing the danger or simply not thinking about the danger. Others simply state the statistics do not apply to them since they are careful. Others deny fishing is dangerous, or state that it is no more dangerous than other occupations. Some simply refuse to listen to the information about the dangers in their industry.

As for safe practices, many superficially comply with the safety regulations by failing to install or maintain the equipment properly. Some fail to turn on the machine and never perform the regular maintenance that is required. Many do not attend safety education programs and they attend only if the insurance companies require it. Moreover, they knew all the correct safety procedures but did not practice them. This cycle of pattern of denial, trivialization, superficial compliance and a lack of commitment of safety procedures have also been found in Korea and they are responsible for the high rate of accidental injuries and death in Korea, especially in the construction and manufacturing sectors (Kim & Park, 2001; Park et al., 2000; Park, Kim & Park, 1999; Park, Park & Kim, 1998).

Pollnac et al. (1995) point out that the resistance against adopting the safety measure can be linked to multiple contingencies. In other words, earning a living was far more important than following safety procedures. Since Fishermen must earn a living and with the worsening fishing and economic conditions, they were willing to take greater risks. The depleting fishing stocks, increased competition, and increasing debts are forcing many fishermen to take risks they would not normally take. They need to earn high enough income to pay for their loans and provide a decent standard of living for their families. Moreover, fishermen have dealt with the danger for hundreds of years and dealing with the danger has become part of their lifestyle and subculture. They deal with their anxiety and stress by denying and trivializing the danger. They see safety regulations not as a benefit, but as drain of their resources and time. They do not see much value in safety when their livelihood is in

jeopardy. Thus, safety is a relatively low goal in their priority.

Pollnac et al. (1995) have found that other competing contingencies which makes safety is a relatively a low priority. The most important priority is to have a successful catch that provide economic rewards for themselves and their family. Although they are aware of the inherent risks and danger, they have transformed the negative situation into a positive social norm of being brave and courageous. Overcoming their fear and anxiety and engaging in the dangerous occupation is further rewarded by social approval and respect from their peers. Rather than seriously considering the dangers in the industry, fishermen tend to trivialize it. Some fishermen point out that he and other fishermen have gone on numerous successful trips many times before; hence, the probability of accident must be so small as to be almost nonexistent (p. 158). Denial and trivialization have become a coping mechanism and bravery and courage have been exalted as a social norm. Many focus on subjective beliefs that they will not be involved in an accident and also resort to supernatural control. As a result, these fishermen are poorly informed and cannot identify the real statistical pattern of danger (p. 158).

Fishermen in New England have developed a subculture of denying danger and ignoring risks as a social virtue. As a result, they are not likely to engage in known safe practices, refuse to participate in safety education program and also when they do participate, they do not benefit from it. When fishermen are faced with the choice between attaining a positive outcome (financial and social rewards) that is concrete, with high probability, and which they have considerable amount of skill versus preventing a negative outcome (accidental injury or death) that is diffuse, with low probability (albeit catastrophic), and which they have little knowledge, interest or skill, many fishermen choose the former option. Unless these competing contingencies are managed effectively, in which safety become a high priority; it is unlikely that these fishermen will engage in safe practices.

Overall the USA has excellent safety records for most industries, but the fishing industry is an exception. The primary reason for the poor safety record is the competing contingencies, which places a low priority on safety. Perceived risk and danger are managed by denial and trivialization. Taking risks are given social approval and recognitions by fellow fishermen. Those who are able to engage in this dangerous industry are often rewarded with successful catch that provide the economic base for their family and their standard of living. Thus, promoting safety cannot be isolated to the individual level. In order to reduce the risks of accidental injury and death, safety must emerge as the highest priority and safety programs must be systematic and integrated at the individual, relational, and collective levels.

Accident, Safety and Culture: The Korean case

In developing countries, such as Korea, the rate of accidental injuries and death at home, in the workplace, and in society is high. As pointed out above, most Koreans perceive injury and death caused by accidents as the most important social problem facing Korea. They are also aware that they can fall victim. As with the New England fishermen, Koreans have misconceptions about accidents and safety. Moreover, with the competing contingencies for economic benefits, parents, employees, employers, and government officials often place safety as a low priority. This is especially the case for traffic accidents (Park & Kim, 2001) and for small industries in Korea, which have the highest rate of accidental injuries and deaths (Park, Kim & Park, 1999). In order to reduce accidental injury and death in the home, school, workplace, and society, Koreans must work together in promoting safe practices at the individual, relational and collective levels.

Korean concept of control and safety

As described above, the concept of control can be defined at three levels: individuals, relational, and environment (See Figure 5). A series of studies conducted indicate that Koreans emphasize secondary and proxy control. In other words, in order to obtain their goals, most people use

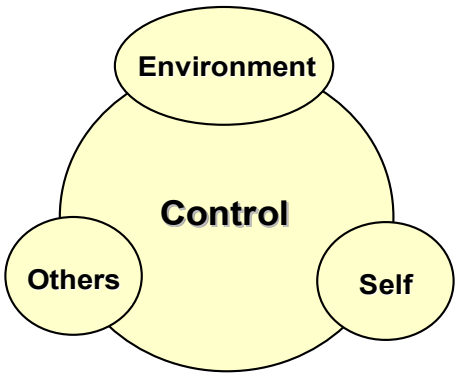

Figure 5. Control

self-regulation as a way to achieve the goals and often rely on parents for social support (Park, in this issue). This result has been consistently found in the area of achievement and failure experiences (Kim & Park, 1998; Park & Kim, 1999), stress (Kim & Park, 1997; Park & Kim, 2000), and accidents and safety (Kim, Park, & Park, 2001; Park & Kim, 2001; Park, Kim, Song, Park, & Han, 2000). Koreans emphasize effort, hard work, persistence and diligence in achieving their goals, reducing stress, and avoiding failures and accidents. They rely mainly on their parents for social support.

Individual level

In the above studies, Koreans attribute their success to self-regulation and failure to a lack of self-regulations, even in the area of accidents. In other words, they focus on managing themselves and not managing the environment. Although self-regulation is an effective when it comes to

academic achievement (Kim & Park, 2002) and stress management (Kim & Park, 2001), focusing solely on secondary control can be problematic when it comes to safety and accident prevention. Even employees, who are victims of an industrial accident, report that lack of self-regulation was the cause of the accident (Park et al., 2000). Second, Koreans obtain assistance from ingroup member, such as parents, but they do not rely on outgroup members, such as experts. When they are involved in an accident, it is the parents who provide necessary support. Fourth, in order to prevent accidents, 75% Korean adolescent report self-regulation as the most effective strategy for preventing accidents and 91% report self-regulation as the most effective strategy for promoting safety, (Park & Kim, 2001). Third, when safety efficacy was measured among primary, junior high, senior high, and university students, the overall means for the all the subscales (Self-regulatory efficacy, Enlisting social support, Managing the environment, and Safety efficacy) decreased with age. In other words, efficacy to prevent accidents and promote safety decreased with increasing age.

Koreans rely exclusively on self-regulation and assistance from their parents to prevent accidents and promote safe practices. They do not report obtaining assistance from experts or managing the environment to reduce the overall risk. Koreans tend to perceive accidents in a deterministic manner and not in probabilistic manner. They try to minimize the outcome at the individual level rather than reducing the probability at the societal level. Similar to the New England fishermen, Koreans do not try to reduce the risk through the controlling the environment, but try to minimize the damage through self-regulation. This is based on the extensive skills that they have developed, both individually, relationally, and collectively in managing themselves and their ingroup members. In contrast they have not developed the necessary skills in working with outgroup members and developing viable institutions.

In summary, there is a cultural and indigenous belief that self-regulation is the best way to achieve success. Most employees believe that the best way to prevent industrial accident is through self-regulation (i.e., stay vigilant, work diligently, and avoid risks). Even those employees, who are hospitalized after an industrial accident, report that the cause of the accident was due to lack of self-regulation (Park et al., 2000). Adolescents in Korea believe that cause of personal injury and accident was due to a lack of self-regulation. In other words, Koreans often ignore the environment factors and the role of other people play in contributing to industrial accident and personal injury, while over-emphasizing the role of self-regulation. In many cases, even if an individual was extremely careful, industrial accidents and personal injury occurred.

In Korea, experts play a limited role in preventing accidents and promoting safety. In school and industries, teachers and safety educator

serve as providing the necessary information, but they do not play an active role assisting individuals and groups in acquiring the necessary knowledge and skills in preventing accidents and promoting safety. Even in industries that are prone to accidents, safety education tends to be superficial at best and many employees report sleeping through the sessions (Park et al., 1998). As Thomsen (1991, 1997) has found, providing practical training is the most effective way to promote safe practices, while formal education and simulation were ineffective. As a result, a large number of Koreans (66%) report that they are not actively engaged in safe practices, even though they know that they can fall victim to an accident (Han, in this volume).

Companies and industries

At the industry level, there is a competing contingency between the profit motive and safety. The primary reason for a company to exist is profit. Owners are motivated to maximize the profit and employees receive their salary from the profit. In order for a construction or manufacturing company to generate a maximal profit, mass production, quick turnover, cheap labor, and low overhead costs are necessary. Safety often runs counter to the profit generation, installing safety devices can be expensive, and they can reduce the speed and volume of production. The short-term cost of investing in safe working environment and safety devices, educational programs, and instilling safe working practices are often seen as being expensive, prohibitive and unnecessary. Many executives who operate small to medium size businesses are not fully convince of the long term benefits of providing a safe working environment or do not have financial capital to invest in such programs. As a result, the health and welfare of the employees are put at risk.

When the management and employees are faced with the choice of between attaining a positive outcome (financial reward) that is concrete, with high probability, and which they have considerable amount of skill versus preventing a negative outcome (accidental injury or death) that is diffuse, with low probability (albeit catastrophic), and which they have little knowledge, interest or skill, many executives and employees choose the former option (Park et al., 1998, 2000). This has been more pronounced during the IMF economic crisis (Park et al., 2000). In a review of safety climate, Hoffman and Stetzer (1998) point out that positive safety climates result when an organization's managers are committed to and personally involved in safety activities, provide and support safety training programs, and emphasize safety issues within the organization (for instance, in meetings) and when accident investigations are oriented to problems solving and counseling (p. 645).

At the psychological level, individuals have a deterministic attitude towards industrial accident and occupational safety. As pointed out above,

most Koreans believe that if one is careful and vigilant, accidents will not occur, at least not to them. However, industrial accidents occur due to problems at three levels: unsafe working environment, organizational culture that condones unsafe work practices, and the lack of safety consciousness and practices of individual employees. These factors work together in an interactive fashion in increasing the probability that industrial accidents will occur.

Governmental agencies

In Korea, governmental policies and regulations are often developed in a reactive, haphazard and bureaucratic fashion. They often do not address competing interests of economic concerns, labor interests, and psychological and cultural factors. For example, the government ministry that promotes productivity and economic growth develops its own guidelines and policies that often run counter to the ministry of labor or public health that are responsible for protecting the rights and safety of the employees. The lack of integrated and consistent government policies and regulations result in excessive and incoherent bureaucratic red tape (Han, in this issue). The lack of viable and effective policies hampers both productivity and occupational safety. As a result, both management and employees must deal with

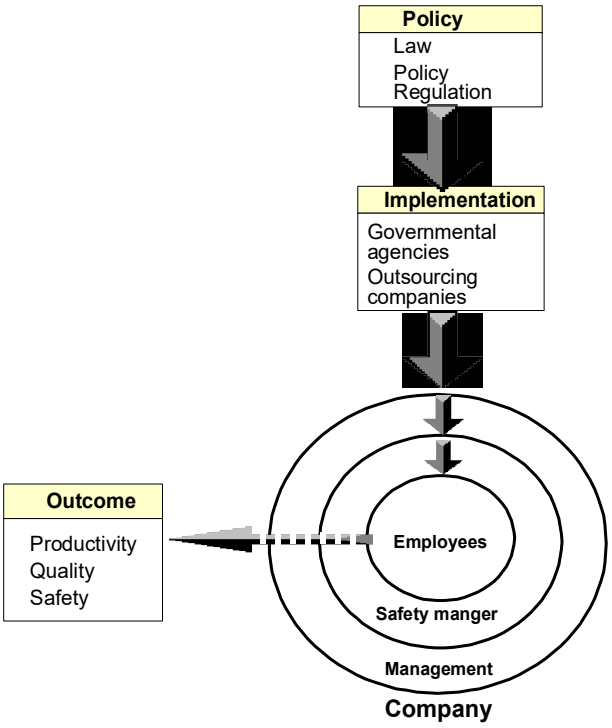

Figure 6. Top-down approach

cumbersome, contradictory, inefficient and multi-layered government policies and regulations.

Secondly, government policies and regulations are developed without the consultation of companies or labor. Government policies often represent the ideal textbook model that is out of touch with the real world. It is an example of a top-down approach. (See Figure 6). Government agencies simply pass new laws and regulations and they are not actively involved in overseeing the implementation of its policy and safeguarding the workplace environment. As a result, many companies and employees simply ignore these policies and guidelines and fail to implement concrete guidelines and programs that could help to reduce industrial accidents and promote occupational safety. When businesses do not comply, government officials often turn a blind eye to the problems. In other situations, companies are simply allowed to continue their unsafe practices by incompetent or corrupt officials.

At the national level, there is a high degree of distrust of government officials and institutions. In a national survey conduct in 2000, less than 10% of Koreans trust politicians and political institutions and similarly low percentage of people trust governmental institutions (Kim, 2002). Han (in this issue) note that a large number Koreans (68%) feel that the governmental agencies are not ensuring safety in public settings. As a result, 64% are worried that they could become a victim of an accident in a public setting (Han, in this issue).

Integrated framework

In a series of interviews with employees from the manufacturing and construction industries and those who have been hospitalized from an accident, these employees point out numerous structural problems that compete with safe practices (Park et al., 1998, 1999, 2000). First, many employees point out that the primary goal for the management is obtain maximal profit and safety is relegated to a low priority, especially for small companies. Companies do not invest in safety devices and safety education since it runs counter to their profit-motive. In the press industry, employees are encouraged and even forced to avoid using safety devices to speed up production. Many employees end up loosing their fingers or limb. Second, many owners and managers in the press industry have lost their fingers or limb and they herald it as a symbol of pride and courage. Third, safety education is seen as an unnecessary burden that is imposed by the government. Fourth, safety education is abstract and superficial and employees do not value them since they already know the right answers. Fifth, safety inspections are superficial and punitive. In other words, companies are punished if they do not follow safety regulations and the government does not provide the necessary assistance in providing practical and beneficial programs. For the management it is often cheaper to falsify the inspection (i.e., bribing government officials) or paying the fine, instead of implementing safe

practices.

With the emphasize on rapid economic growth and attaining a high standard of living, the general public, employees, management, and government officials have fostered and encouraged a culture of maximal production and profit, which runs counter to safety practices. In the construction industry, speed, efficiency and cost are valued over safety. In the roads and sidewalks, the number of cars and pedestrians exceed the safe levels. As a result, some pedestrians venture out on the road and some cars venture into the sidewalk. Motorcycles have become efficient vehicles since they can weave between traffic and use the sidewalk when needed. As a result, vulnerable groups, such as children and employees working in a small company, fall victim to accidental injury and death. Major accidents, such as collapse of a bridge or building, or fire are indiscriminate and catastrophic. The basic problem is that Korean society has invested most of its effort and skills in rapid progress and development and has not invested enough time, resource, and skills for safety management.

Rather than a top-down approach, an integrated approach that address the three levels of analysis (individual, relational, and collective), and which integrates different context (e.g., family, school, work, and society) is necessary. In the industrial sector, the integrated approach is outlined in Figure 7. (See Figure 7). Governmental agencies, companies, and employees must participate in developing a realistic and practical safety programs that can reduce the probability of industrial accidents. The way to reduce industrial accidents is to reduce the overall probability by working at all three levels in a systematic and integrated

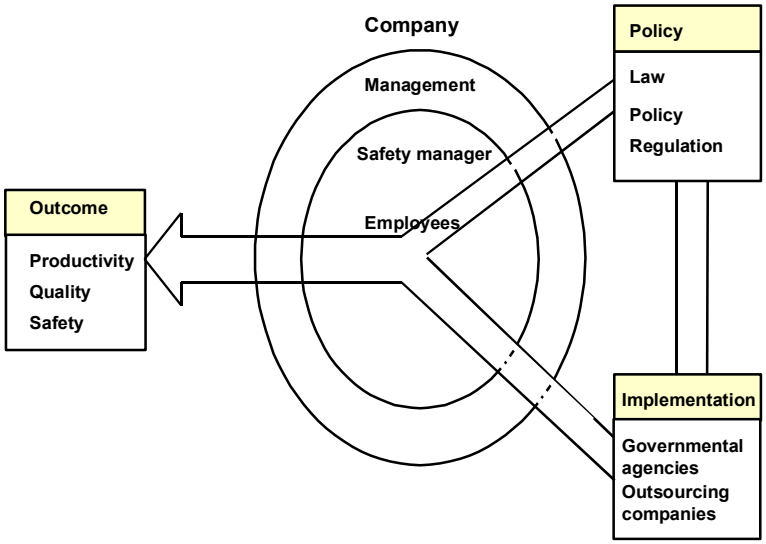

Figure 7. Integrated approach

manner. Focusing on just one level (i.e., educating and promoting safe work practices among the employees) will be not successful. In some instances, it can create a false sense of security, that could in turn, increase the chances of industrial accidents.

At the individual level, the problem with self-regulation is that it can produce habituation. In other words, engaging in safe practices does not produce an outcome that is visible or consequential in most situations. For example, wearing a seat belt does not produce a visible or consequential outcome in normal circumstances. Many employees, who do not wear a safety device, are not injured in most cases. Only if one is involved in an accident, one realizes the benefits of wearing a seat belt. However, in most cases, drivers are not involved in a car accident and thus wearing a seat belt produces a visible outcome only in a rare occasion of an accident and not in normal circumstances. As a result, individuals can become habituated and then may not continue the safe practices, such as wearing a seat belt.

In most countries wearing a seat belt is mandatory by law since it reduces serious injury if and when an individual is involved in an accident. At the national level, it reduces serious injuries due to car accidents, but for the vast majority of people who are who are not involved in car accident, wearing a seat beat produces no visible outcome in normal circumstances. At the relational level, if an adult is wearing a seat belt, children are more likely to also wear a seatbelt (Miller et al., 1998). Analysis of children and adolescents, who are seriously injured because they were unrestrained, reveal that the accompanying adult was not wearing a seatbelt (Miller et al., 1998). The actions of the parents influence the behavior or children at and when parents do not engage in safe practices, they often put their children of risk of serious injury and death.

Since automobile and industrial accidents are relatively rare, the deterministic view can undermine engaging in safe practices. Only when individuals are taught about the probabilistic nature of accidents, prevention is possible and effective. Simply providing this probabilistic information is not enough. Governments, companies, and individuals need to work together in reducing the overall risk of industrial accidents. This can be done by working at all three levels: 1) creating a safe environment, 2) creating a culture that promotes safety, and 3) promoting safe practices at the individual level.

Educational programs that promote safe practices must occur at early age at home so that the children will understand the probabilistic nature of accidents and injury and engage in preventive activities. They must be taught practical skills in the relevant context (Thomsen, 1991, 1997). Safety consciousness and practices must become part of a lifestyle and become a habit, before they habituate. For example, it is well known that brushing one's teeth reduces the overall chances of tooth decay and gum disease.

Similarly, healthy lifestyle practices, such as exercising and eating healthy food, reduces the chances of becoming ill. Similar preventive model need to be developed and implemented in Korea. In other words, the basic cause of accidents is probabilistic in nature and it could cause personal injury at home, school, work or society at large. In order to prevent these accidents, governments, organizations, expert, family members, and individuals need to learn about the probabilistic nature of accidents and to develop concrete programs, skills and practices that reduces the overall risk.

Family members, schools, organizations, and government must work together in educating the children and teaching them the basic skills. Adults must acquire these knowledge and skills before they can teach them to their children. In order to promote safety, it has to become a top priority, rather than relegated it to a lower status. Only when all individuals and segments of Korean society place safety as it top priority and are engaged in safe practices, the risk of accidents will be reduced.

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인간, 과학기술과 환경의 대한 이해: 사고와 안전에 대한 확률론적 시각과 결정론적 시각의 토착 문화적 분석

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이 연구에서는 토착 문화심리학을 토대로 사고와 안전에 대한 확률론적인 시각과 결정론적인 시각을 비교 분석하였다. 한국뿐만 아니라 대부분의 선진국이나 개발도상국에서 사고로 인한 사망과 재해는 예방이 가능하다. 이 연구의 첫 번째 부분에서는 사회과학과 응용과학에서 채택되어온 선형의 결정론적인 모형의 한계에 대해 설명하였다. 가정 직장과 사회에서 발생하는 사고와 안전의 확률론적인 속성에 대한 이해를 위해, 토착 문화심리학에서 주장되어온 상호작용 모형이 제안되었다. 두 번째로는 사고와 안전에 관련된 요소들을 검토하였다. 세 번째로는 한국사회에서 사고를 예방하고 안전을 증진하기 위해 확률론적 모형의 활용에 대해 설명하였다.

주요어 : 사고, 안전, 재해, 결정론적 시각, 확률론적인 시각, 토착심리학, 통제, 자기효능감