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Perceived Risk and Driving Behavior: Lessons for Improving Traffic Safety in Emerging Market Countries

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Abstract

Very often the risks of driving are expressed in terms of the total number of deaths that occur yearly as the result of motor vehicle operation. Yet, despite the thousands of people who die each year in automobiles in the U.S. alone, driving behavior seems relatively unresponsive to statistical portrayals of risk. Research in risk perception suggests that this apparent unresponsiveness is rooted in the manner by which risks are psychologically evaluated and judged. In general, perceptions of controllability of a hazard are a prime factor in personal assessments of its riskiness. Unfortunately, drivers appear to have an exaggerated sense of their personal control over driving situations and hazard potential, leaving them unrealistically optimistic about their chances of avoiding harm. However, emerging market countries seeking to develop better motor-vehicle risk management are cautious about drawing too heavily upon risk perception research conducted in industrialized countries with mature risk management institutions — risk as a concept appears highly conditioned on the cultural context within which it is experienced. Thus, emerging nations are encouraged to develop risk management approaches within their own cultural matrix, relying on a base of research stimulated by cross-cultural collaboration.

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Introduction

> ". . . Knowledge counts for nothing if it can be touched with a word but not experienced." (from One Human Minute, Stanislaw Lem)

In the United States, the number of fatalities associated with motor vehicle accidents has generally hovered at about 45,000 to 50,000 per year, with approximately 15% of those fatalities being pedestrians. Part of what is interesting about these numbers is their relative stability in recent years suggesting that, from a public perception perspective, it is as if these tens of thousands of deaths in and of themselves do not compel us to exercise any greater safety as drivers. Indeed, were these deaths fully appreciated by all drivers, passengers, and pedestrians as well as all other users of the roadways (e.g., moped riders, motorcyclists, bicyclists), the psychological impact of such enormous suffering and grief would seem to overwhelm any incapacity we might have toward exercising extreme caution. Certainly, near-death experiences and close-call accidents in one's own life, or the lives of those close to us, have the power to provoke a more cautious nature. But why don't 50,000 motor vehicle fatalities (and even more on a world scale) move us as they should? Why do mortality and morbidity statistics fail to be appreciated and translated directly into safer driving behaviors? Why do efforts to communicate societal risks through risk statistics alone consistently lead to little or no success?

The answers to these questions lie in understanding the psychological experience of risk and how risks are perceived. In this paper, we shall review current conceptualizations of risk perception and attempt to tie that review to issues in transportation safety. We will offer some speculations, based on this research, concerning what might be done to improve transportation safety from the perspective of human behavior. And, finally, we will cast risk perception research in a cross-cultural framework and identify some potential directions for the development of transportation risk management in emerging market countries where risk management is either limited or non-existent.

Perception of Technological Risks and Hazards

The study of risk perception has been central to risk management at least since the 1960's. At that time, risk regulators were intensely concerned with the development of risk-management strategies that were both consistent and efficient in terms of economic principles and sensitive to broadly held public attitudes about risk regulation. The search for suitable regulatory standards for risk led to the examination of past risk decisions as a basis for new management strategies. Motivated by the question "How safe is safe enough?" early researchers looked to quantitative measures of risk, such as expected loss or cost per life saved as potentially solving the dilemma of what standards to set for new risks for which there was little (or no) economic or regulatory experience. An early study by Chauncey Starr (1969) of the Electric Power Research Institute was of particular importance because it identified a set of factors that offered at least an initial description of how nontechnical perceptions of risk play a role in the relative level of societal resources committed to reducing different kinds of risks. He noted that fundamental differences existed in both the nature and extent of regulation for voluntary activities than for involuntary ones. Particularly, Starr's analysis revealed that the level of risk the public is willing to accept from activities it views as voluntary (e.g., skiing) is approximately 1,000 times greater than for risks it views as involuntary (e.g., food additives),

assuming the same level of benefit. Starr's "revealed preferences" approach was an attempt to show what has been traditionally acceptable as revealed by past societal decisions involving health and safety risks.

Starr's work set the stage for what has become a much deeper psychological examination of factors that contribute to people's judgments and perceptions of risk, and the fundamental differences that exist between lay perceptions of risk and those of experts. One of the earliest psychological studies of perceived risk was by Fischhoff, Slovic, Lichtenstein, Read, and Combs (Fischhoff, Slovic, Lichtenstein et al., 1978). They studied the relationship between a set of perceptual dimensions or "risk characteristics" and lay people's perceptions of risk, benefit and level of risk acceptability for 30 different hazardous technologies (e.g., nuclear power, power mowers, motor vehicles), activities (e.g., hunting, police work, skiing), and substances (e.g., food preservatives, pesticides, antibiotics). Acceptable risk was found to be greater for voluntary risks than for involuntary ones, reflecting the results of Starr's studies. Furthermore, acceptable risk levels were higher for risks viewed as chronic (not catastrophic), common (not dreaded), known to those exposed, known to science, controllable, and familiar. Thus, relatively benign risks from a perceptual standpoint were judged more acceptable than were ones for which significant uncertainty (e.g., unknown to science) or emotionality (e.g., dreadedness) were associated.

The framework used by Fischhoff et al., for characterizing non-expert perceptions of risk has come to be known as the psychometric paradigm, which itself grew out of work utilizing psychophysical scaling and multivariate analysis techniques to produce representations of attitudes and perceptions. Psychometric analyses of risk are typically done by asking respondents, generally members of the public or of some specific group of interest, to evaluate a number of different technologies, activities, or substances in terms of characteristics that relate to the social context of risk. The resulting judgments are then used to develop a characterization of the set of risks in terms of (typically) two general, independent factors comprised of combinations of the larger set of judgment or risk characteristic scales.

The results of one such study (Slovic, Fischhoff & Lichtenstein, 1986; Slovic, 1987) reveal two basic factors at work in determining how lay people perceive risk. One factor can be characterized as an emotional or affective factor comprised of properties such as controllability, dreadedness, and potential for catastrophe. A second factor relates to perceptions of uncertainty about a hazard both by of those exposed and by science. Thus, risks having a high emotional or affective charge, accompanied by a relatively high level of uncertainty concerning the state of one's personal knowledge about the hazard or the state of knowledge of scientists, are of particular concern, and are likely to draw particular attention when, for example, they are reported in the media (MacGregor, 1991). Other studies of risk perception have shown that these concerns relate strongly to protective behavior that people take to reduce their exposure to risk (Slovic, MacGregor & Kraus, 1987), and to people's desire for risk regulation (Slovic, Fischhoff & Lichtenstein, 1986).

Figure 1 shows graphically a factor space containing 81 hazards. Of particular note is the position in the space of "auto accidents" — generally, in the United States at least, motor vehicle operation is looked upon as a relatively controllable risk, not particularly dreaded, quite familiar, and a risk that is known to those exposed. Thus, in many ways, motor vehicle risks judged in the broader scheme of risks that people face in western society are not perceived in negative terms, at least as an activity that poses risks to society at large. However, we would argue, it is exactly

this character of motor vehicle risks that potentially inhibits people's ability to appreciate these risks. That drivers tend to perceive motor vehicle operation as an activity that is under their control can also lead them to minimize its dangers.

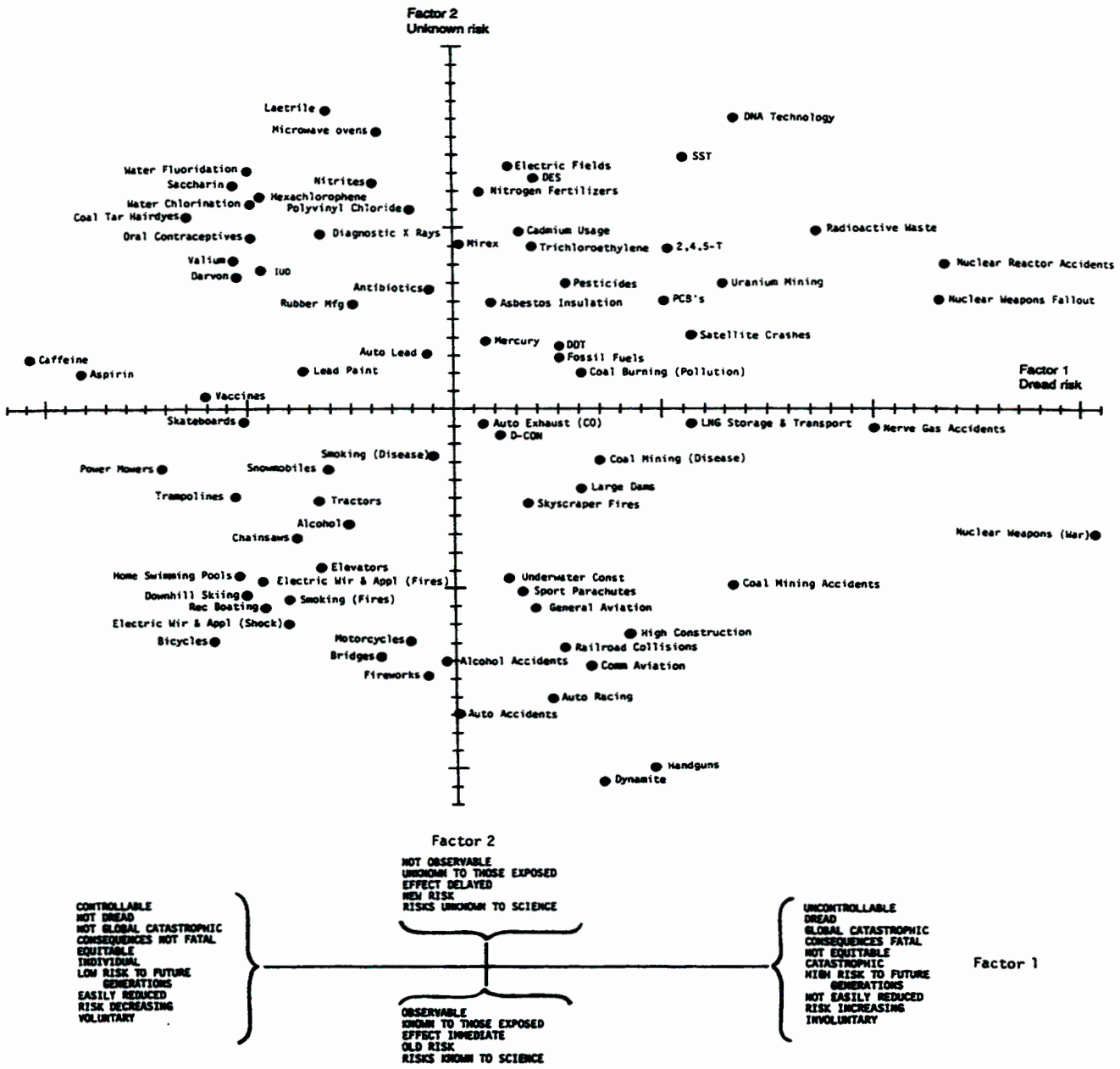

Fig. 1. Location of 81 hazards on factors 1 and 2 derived from the relationships among 18 risk characteristics. Each factor is made up of a combination of characteristics, as indicated by the lower diagram (*25*).

This general framework for conceptualizing the perceived risks of motor vehicle operation can have direct implications for how drivers judge the safety of their vehicle, either because it is defective or because one or more of its critical systems (e.g., brakes, steering) may be malfunctioning. Slovic, MacGregor and Kraus (1987) had a group of drivers aged 17 to 38 evaluate 40 scenarios describing automobile defects that had led to the vehicle being recalled by the manufacturer for correction. Each scenario consisted of a short paragraph indicating the nature of the defect and the consequences to the vehicle operation that might result should the defect go uncorrected. The scenarios were selected from actual automobile recall listings compiled by the U.S. Department of Transportation. For example, one scenario described a potential braking system defect as follows:

> "The valve in the braking system that controls the amount of braking effort applied to each of the wheels may distribute greater braking force to the rear than to the front brakes. As a result, the rear brakes may lock up, potentially causing loss of vehicle control."

Subjects in the study rated each scenario on a number of risk-characteristic scales, including dreadedness and severity of consequences, observability of the defect, manufacturers' potential knowledge of the defect, importance of the vehicle system involved, riskiness of operating a vehicle with the defect, and likelihood of complying with a recall notification. A two-factor structure resulted from an analysis of scale ratings, with the first factor characterized by uncontrollability of damages, and a second factor characterized by the manufacturer's ability to foresee the defect and its consequences. Perceived risk correlated highly with the two-factor structure ($r = .89$). Self-ratings of compliance along with the two-factor structure were highly successful in predicting *actual* recall compliance rates taken from U.S. Department of Transportation records ($r = .71$). These findings are instructive because they indicate that behavior with regard to improving motor vehicle safety, at least in the case of attending to potential vehicle defects, is strongly related to perceptions about the nature of damages resulting from operating a defective vehicle and from the foreseeability of such damages. For the improvement of driving safety, these results suggest that drivers need to be made aware of the potential consequences of operating an unsafe vehicle in terms specific to actual defects.

In a related study, MacGregor & Slovic (1989) examined how drivers' perceptions of the component systems in automobiles related to perception of the safety of their vehicles. Subjects evaluated a set of 30 subsystems constituting a functioning motor vehicle. These included brakes, steering, suspension, engine, electrical, and fuel systems. The 30 subsystems were rated in a set of characteristic scales, including likelihood of a severe consequence should the system fail, observability of impending failure, riskiness of the vehicle with improper system operation, manufacturer's responsibility for consequences, and need for federal regulation of system design. Again, the psychometric analysis lead to a two-factor space, with a first factor characterized by severe and uncontrollable consequences, and the second factor characterized by drivers' ability to observe a defect in the system.

Not unexpectedly, high perceived risk component systems included brakes, steering, wheels/tires and fuel. However, when the perceived risk ratings of these various systems were aggregated into the eight Vehicular Causal Factors developed by Treat and colleagues (Treat, 1980; Treat & Stansifer, 1977) and compared with *actual* accident risk, some interesting results emerged. Perceived risk and statistical risk compared favorably for brakes, wheels/tires, steering, body, power train, and suspension. However, a large discrepancy between perceived risk and accident data occurred for the communication system. Communication systems are the vehicle systems and components used for communicating between drivers, and include turn signals, headlights, marker lights, stop lights, window glazing and horn. Typically, drivers significantly underestimated the role of these components in accident causation. This finding is interesting from at least two perspectives. First, it illustrates the lesser degree of attention that drivers may give to insuring that they are able to make others on the roadway either aware of their presence or knowledgeable of their intentions. Thus, it suggests an attitudinal tendency toward "seeing" rather than being "seen." But more broadly, it perhaps reflects an inclination for drivers to operate within a sphere of personal control, of which they are at the centroid.

Perceptions of risk are influenced by perceptions of benefit.

Amid accident statistics and discussions of the need to improve transportation safety, it is often easy to overlook the important role that benefit perceptions play in the perception of risk. Research on perceived risk in the psychometric paradigm has found that the acceptability of risk is correlated with the perception of benefit: technologies and their risks are perceived as more acceptable to the degree that they provide greater benefits (e.g., Vleck & Stallen, 1981). More recent work in risk perception has attempted to shed light on the underlying psychological mechanisms that may account for risk/benefit correlations. Finucane, Alhakami, Slovic, and Johnson (1998) found that providing people with benefit information about an activity or technology tended to depress their perception of its risk. They explained this result in terms of an affective model, by which activities having both risk and benefit properties are evaluated in terms of a net "goodness" — as benefit is added to the equation, risk decreases, and vice versa (Alhakami & Slovic, 1994).

For those of us living in industrialized countries, we can scarcely imagine what life would be like without motor vehicles and other forms of modern transport. Over time, these benefits are assumed as cultures become more accustomed to and dependent upon motor vehicles for daily life. Many of the measures a society can take to improve traffic safety come at the cost of decreased benefits. For example, slower roadway speeds and more traffic control signals can potentially reduce accidents and/or their severity, but are purchased with increased travel times and driver inconvenience. In light of the high benefits of driving, these risk-reduction measures can be seen more in terms of a loss of benefit than a gain in safety. Indeed, whether risk-reduction and management is viewed as a gain or a loss can strongly influence its prospects for success (e.g., Gregory, Lichtenstein, & MacGregor, 1993).

Drivers can be unrealistically optimistic.

For drivers to take steps toward improving their safety, they must first recognize the need for it. Unfortunately, the tendency for most drivers is the opposite. Indeed, motor vehicle operators tend to suffer from over-optimism, generally evidenced by a proclivity to evaluate themselves as better than the average driver or less likely to be involved in an accident. For

example, Svenson, Fischhoff and MacGregor (1985) asked Swedish and U.S. drivers "how safely do you drive relative to the average driver?" Of U.S. drivers, 78% viewed themselves as safer than average drivers, while only 59% of the Swedish drivers rated themselves as safer than average. This tendency toward unrealistic optimism regarding one's personal chances of harm compared to that of one's peers has been the subject of much research across a range of health hazards (e.g., Weinstein, 1989; Weinstein & Klein, 1996).

The laws of physics that apply to driving are not well understood by drivers.

Motor vehicle operation occurs within the context of a physical reality. Automobiles have weight and mass, and their movement represents enormous stored energies. In stopping a vehicle, that energy must be converted over time to other forms, such as heat. In collisions with other objects, the energy stored in the mass of the automobile and its occupants must also be dissipated. Though the laws of physics by which these energies are accumulated, stored, and transferred are well known to science, they are not necessarily well understood by drivers. For example, a common perception of many drivers is that they are able to restrain an occupant in the passenger seat (such as a young child) during a sudden stop by simply putting their arm in front of them. While this may be possible in a gradual stop, this is virtually impossible in a collision at even slow roadway speeds. Likewise, drivers who believe they will be able to restrain their forward motion in a "fender bender" collision in slow traffic by bracing themselves with the steering wheel are often surprised by the sudden (and many times injurious) negative acceleration they experience when the vehicle ceases its forward motion, but their body does not. The failure of drivers to fully appreciate these physical realities can potentially lead them to not undertake protection actions, such as utilizing their seat belt or putting a child in a safety seat.

Unfortunately, we have very little research on drivers' intuitive models of the physics of motor vehicle operation. We speculate that were such research done, it would reveal that drivers' mental models of physics either lack important concepts, or contain severe underestimations of the forces and energies involved in the relationship between the vehicle and its speed, its occupants, and the environment, as well as in the time frame required for those energies to be safely transferred and distributed.

Risk statistics are often not in a form that have personal meaning or relevance.

The statistical risks of driving are seemingly high when expressed as, for example, a single large number of fatalities occurring over the period of (typically) a year. However, what most drivers actually experience in operating a motor vehicle is a large number of safe and relatively uneventful trips. Thus, accident statistics are strongly at odds with what their experience apparently tells them about the safety of the road. Though accidents do occasionally happen, they happen to other people. Thus, the thousands of deaths and injuries that seem to occur are associated with some other universe of people, and one's own driving experience leads to continual reinforcement of one's abilities and safety.

Unfortunately, however, experience is often a very poor teacher. For example, one can be a particularly poor driver and never become involved in an auto accident. Part of the difficulty of using experience to educate drivers about automobile safety is that feedback is not necessarily sensitive to vast differences in riskiness. Essentially, it is difficult to learn from experience because feedback is not "tuned" properly. If it were, drivers who engage in risky behaviors (e.g.,

rolling stops, excessive speed, dangerous passing) would be punished quite frequently. Instead, feedback comes only probabilistically and then only rarely. In cases where the feedback results in fatality, it comes too late.

However, statistical information can sometimes be compelling and (at least) influence attitudes about protection behavior. For example, Slovic, Fischhoff & Lichtenstein (1978) found that drivers were more positively inclined toward seatbelt use when accident statistics were presented on a lifetime basis (i.e., 1 in 3 probability of serious injury and 1 in 100 lifetime probability of a fatal accident) than on a trip-by-trip basis (i.e., 1 in 100,000 probability of an accident and 1 in 3.5 million probability of fatality per trip). Thus, drivers encouraged to think of accident potentials over a lifetime of their own driving may adopt more positive attitudes toward self protection.

Risk is experienced in a cultural context.

In recent years research on risk perception has become oriented toward the influence of social and cultural processes. The desire to take greater account of the cultural context within which risk is experienced has resulted from a growing realization that risk means different things to different people and that cultural values weigh heavily in definitions of risk. This strain was already evident in early cross-cultural risk perception work done in the psychometric paradigm. For example, in a cross-cultural comparison of risk perception, Goszczynska, Tyszka, and Slovic (1991) found that there was considerable agreement in risk perceptions in Polish and American samples. However, Englander, Farago, Slovic, and Fischhoff (1986) found systematic differences between Hungarian and American respondents in their ordering of risks, with Hungarians more concerned about common or everyday hazards such as cars, trains, and electric appliances. The focus of Americans on newer, less well understood hazards was in contrast with Hungarians' concerns about the "failure of machines and the people who operate them" (p. 64). A study of Norwegian vs. American risk perceptions yielded similar results; Norwegians were more concerned about "known" risks than were Americans (Teigen, Brun, & Slovic, 1988). The same focus of concern on known risk is also evident in studies of Japanese risk perception (Kleinhesselink & Rosa, 1991). However, Keown (1989) found little difference in the structure of risk perceptions of Hong Kongese versus Americans, though some specific hazards were of more concern to one cultural group than another. Some of these differences were attributable to cultural factors (e.g., Hong Kongese drink in moderation and so alcoholic beverages are seen as less of a hazard), while others are related to differences in regulatory emphasis (e.g., heroine and crime). Differences in risk perceptions can also be due to "real" differences in exposure (Finucane & Maybery, 1996).

Even though risk perceptions may bear a similar general structure between cultures, specific hazards can be viewed very differently, with significant implications for risk acceptance and management. For example, Karpowicz-Lazreg and Mullet (1993) found that risk perceptions of the French public generally matched those of the American public except for a few specific hazards, among the most notable of which was nuclear power. Subsequent research has revealed that the generally greater acceptance of nuclear technologies on the part of the French is due in part to a greater public acceptance and trust in risk management and a greater need in France to rely on non-fossil fuel energy sources (see Slovic, Flynn, Mertz, Mays & Poumadere, 1996).

Thus, differences in cultural context can dramatically influence how risks are perceived, as well as the prospects for successful risk regulation and management.

In the case of motor vehicles, cultural factors appear to influence perceptions of driving risks. For example, Sivak and his colleagues have found in cross-national studies of driving in the U.S., Spain, and West Germany that self-assessments of driving ability as well as the tendency to take risks in driving situations differ by country, with U.S. drivers assessing themselves as safer and West Germans exhibiting greater safety margins in simulated driving situations (Sivak, Soler, & Trankle, 1989a, b; Sivak, Soler, Trankle, & Spagnhol, 1989).

More recent work has cast cultural factors in terms of worldviews and orienting predispositions that are related to underlying values and beliefs. This line of research, based on cultural theory, has emphasized risk as reflective of what is important to people vis-a-vis the social institutions they create (e.g., Wildavsky, 1988; Douglas & Wildavsky, 1982). Research in worldviews has highlighted powerful and simplifying strategies that predispose people toward different outlooks that have an influence over their judgments about complex risk issues, even though on the surface these worldviews appear to have little or no relation to risk (Buss, Craik, & Dake, 1986; Cotgrove, 1982; Dake, 1991; Jasper, 1990; Slovic & Peters, 1998; Peters & Slovic, 1996). Some of the more important worldviews identified to date include fatalism (e.g., "I feel I have very little control over risks to my health"), hierarchist (e.g., "Decisions about health risks should be left to the experts"), egalitarianism (e.g., "If people were treated more equally, we would have fewer problems"), and individualism (e.g., "In a fair system, people with more ability should earn more.").

Cultural effects on risk perception can also extend to ethnicity groupings and gender roles. For example, Flynn, Slovic, and Mertz (1994) studied the differential risk perceptions of males vs. females as well as whites vs. non-whites. They found that white males consistently exhibited lower perceptions of risk across a wide range of societal hazards, and concluded that sociopolitical factors contributing to loss of personal control exacerbate perceptions of risk. In terms of driving risk perception, Dejoy (1992) found that males were more inclined than females to exaggerate their driving competency, and tended to perceive less risk across a range of driving situations.

Overcoming cultural barriers to management of unsafe driving, while an obvious problem on a world scale, can still be a problem for nations having a relatively long history of risk management and regulation. For example, in the U.S., alcohol is a contributing factor to a large proportion of motor vehicle accidents. Despite this well known causal factor, however, drinking and driving is still in its infancy in terms of regulation.

Lessons learned: How can we improve traffic safety in emerging market countries?

We return now to our original question, namely: Why don't people respond as they should to risk statistics? And, we reply that risk is a complex landscape of views and perceptions, based on an impression of what people know and believe about the world and about themselves. In the case of motor vehicle operation, that impression is often based on a great deal of successful experience with only occasional difficulty or mishap. The driver's view of himself or herself is very often an optimistic one, heavily influenced by perceptions of control and ability to

manage the driving environment. The enormous benefit and value of driving itself can significantly attenuate the perception of hazard.

There are, however, some glimmers of hope. One comes in the potential for education to improve drivers' awareness and personal attention to risk. For example, research suggests that seat belt utilization may be increased by communicating risks in terms of a lifetime perspective, though laws do even better at causing seat belt use. More driver awareness of the physics of driving may also prove a useful motivator for careful driving.

However, we are quite cautious about extrapolating advice too strongly from research done in (largely western) industrialized countries to emerging market countries. If there is one thing that risk perception researchers have learned in recent years, it is that risk and its management are strongly related to cultural factors, and risk management approaches that are developed and implemented in one culture may not work in another. Indeed, we view risk as a social construction that is equally rooted in scientific or technical views about risk and in broad public attitudes and values that are culturally determined. Thus, the prospects for the development of successful risk management in any country will be improved, we believe, by the "bottom up" development of risk management and regulation based on culturally-derived definitions and values about technology and technological development (including risk), rather than adoption (with or without modification) of a "top down" regulatory model used elsewhere.

In many ways, the picture that we see today with regard to motor vehicle risks in emerging countries reflects the stage of development of their safety culture (e.g., Smith, 1990). For some industrialized nations, a cultural orientation toward safety is well advanced and is reflected in the range and sophistication of social and political institutions involved in risk and its management. Other nations, however, lack these institutions. As such institutions evolve, their success and acceptability will depend in part on their ability to embrace and to be sensitive to the values inherent in their unique cultural context.

Creating a safety orientation within a culture is, we believe, fundamentally dependent on research. Within the U.S., risk-related research has benefited from the participation of numerous scientists, universities, government agencies, and even private industry for well over 40 years. The results of that effort are evident not only in the body of research capabilities and institutions that we see today, but also in a cultural orientation toward risk and its management.

A lesson that can be drawn from this experience for those who wish to improve the management of risk in emerging nations is to begin by providing support and guidance to these nations' academic communities in terms that foster risk-related research. Though risk management institutions emerge from political forces, they tend to draw their intellectual resources from a nation's academic institutions. Thus, impacting the development of risk management can be done with some efficiency through a nation's higher education system. This can be done in a number of ways, including establishing research grants, funding graduate fellowships, and encouraging collaborative relationships between scientists of industrialized and emerging nations. High level academic degree courses can also be developed and offered, including such topics as risk analysis, environmental issues, ergonomics, and human factors. However, the development of courses, research funding, and collaborative cross-cultural research efforts must derive from the cultural context of the participating emerging nations to the greatest degree

possible, thereby helping to insure that risk management institutions enjoy broad public acceptability.

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