



**Risk Perception:**  
Theories, Strategies, And Next Steps

## Executive summary

Understanding risk and how it is perceived is a crucial step toward creating programs and campaigns to raise awareness and make communities and workplaces safer. This Campbell Institute literature review looks at the current state of research in the area of risk taking and explores the reasons why individuals take risks inside and outside the workplace.

In short, risk perception, or the ability to discern risk, is tied to risk tolerance, or an individual's capacity to accept a certain amount of risk. Research suggests that programs to discourage risk-taking behavior need to address both of these concepts.

This paper summarizes the individual, community and broader societal factors that affect risk perception and tolerance. It then delves into a presentation of several theories explaining risk perception, including theories related to protection motivation, habituated action, risk compensation and social action. Examples of how Campbell Institute Member companies have put these theories and concepts into practice are highlighted throughout the paper.

Overall, the idea presented is that occupational and non-occupational risk taking are related. The factors and theories of risk perception are applicable to a number of on- and off-the-job behaviors. Knowing how and why individuals engage in risky behavior could aid significantly in creating messaging and programs to make communities and workplaces safer.

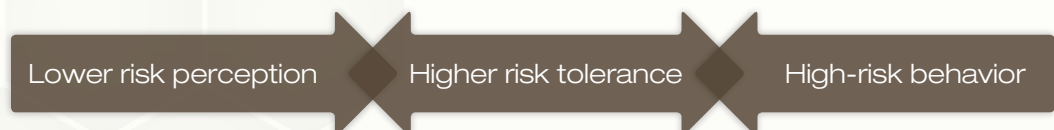
## Introduction

A survey asking for a general definition of “risk” would probably reveal that most people have a basic understanding of what risk means, and may be able to provide an example of what they consider “risky behavior.” Scholarly research and anecdotal evidence tell us, however, that there is no universal conception of risk or how much risk is inherent in certain activities. The wide array of opinions on what is and what is not high-risk means that some individuals are more prone to placing themselves in hazardous situations, often putting others in harm's way.

This literature review attempts to summarize the current state of research regarding risk-taking behavior and explore the reasons why people engage in high-risk behavior inside and outside of the workplace. The idea presented here is that occupational and non-occupational risk taking are related – the factors and theories explaining greater risk tolerance in individuals are applicable to a wide variety of behaviors both on- and off-the-job.

An official definition of risk is “a measure of the probability and severity of adverse effects” (National Safety Council, 2003). In other words, risk is a calculation of how likely an incident is to occur, and given its occurrence, how dire the consequences would be. Being able to accurately assess the risk in a situation or resulting from a set of actions is, at a personal qualitative level, dependent upon an individual's risk perception and risk tolerance.

Risk perception is the ability of an individual to discern a certain amount of risk, and risk tolerance refers to a person's capacity to accept a certain amount of risk. These two concepts, while unique, are very much linked. Many of the theories presented in this literature review postulate that inability to accurately perceive risk may lead to higher risk tolerance levels, which can encourage high-risk behavior. Other theories posit that the causal flow could go in the opposite direction, with habitual engagement in high-risk behavior leading to higher risk tolerance levels and lower risk perception ability. There is research to support both of these models.



It is also possible that a person has the ability to accurately assess risk based on the probability of an incident occurring and the potential consequences of an incident, but that s/he is willing to tolerate higher risks. These so-called “thrill seekers” are evidence that higher risk tolerance levels are not necessarily tied to lower risk perception ability. The research and literature suggest that to discourage risk-taking behaviors, public campaigns and workplace programs must target both risk perception and risk tolerance.

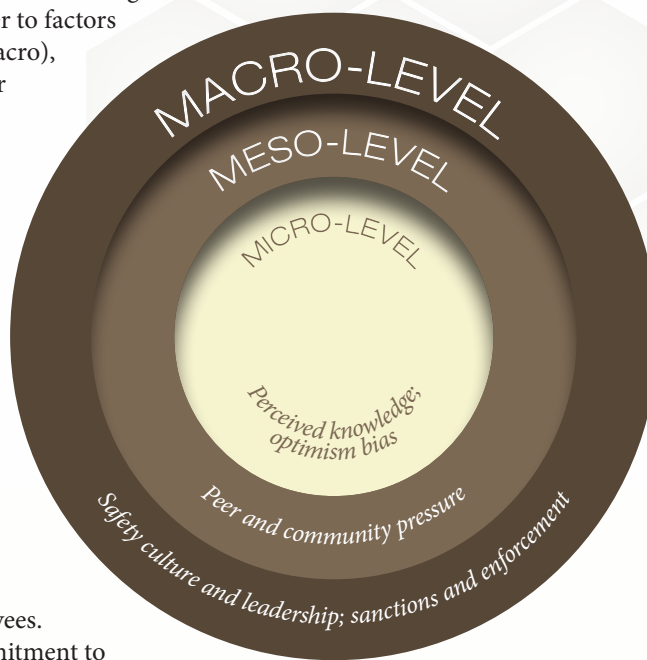
## Factors affecting risk perception and tolerance

Factors that affect risk perception and tolerance can be categorized as macro-, meso-, or micro-level. These levels refer to factors that are structural or institutional in nature (macro), at a peer-to-peer or community level (meso), or at an individual psychological level (micro).

**Macro-level Factors** One macro-level factor, the culture of safety and level of safety leadership within an organization or community, can have a profound effect on individual levels of risk perception and tolerance. The research in this area suggests a need to go beyond mere psychological analyses of individual risk perception and take into account broader social, cultural, and environmental explanations of risk behavior (Weyman & Kelly, 1999). Regarding safety leadership, the approach to safety among an organization’s managers and supervisors can have a significant effect on the perception of safety and risk among employees. When management clearly demonstrates commitment to safety, employee perception of the safety management system is positively influenced, resulting in less risk-taking behavior and a reduction of injury rates (O’Toole, 2002).

Workers employed by an organization with a positive safety culture – an environment with high emphasis on safe work procedures and commitment to employee health and safety – were less likely to take risks than workers employed by an organization without a positive safety culture (Fleming & Buchan, 2002). In a related research study, Garcia et al. (2004) found that workers exposed themselves to more risks and were less likely to comply with safety rules when they rated the safety climate of their organization poorly.

Safety culture also has a broader applicability beyond the workplace. Researchers have explored the concept of traffic safety culture, or how the predominant ideas and beliefs surrounding road safety and driving in a community, state or country influences individual driving behavior and society’s attitudes towards motor vehicle accidents. The argument here is that U.S. drivers are conditioned to believe that car crashes are not preventable and occur purely due to others’ poor driving rather than to larger institutional factors that could have prevented the crash (e.g. laws prohibiting cell phone use while driving, car manufacturing regulations, road maintenance, etc.)(Moeckli & Lee, 2007). Another argument is that as a society, the U.S. seems more concerned with the loss of life from catastrophic events (e.g. terrorist attacks, hurricanes) than the much greater number of deaths from motor vehicle crashes. As Sleet et al. note, “For many, road trauma is simply the price we pay for mobility” (2007:54). These fatalistic attitudes and the idea that society can’t do anything to prevent car crashes can encourage drivers to take more risks if they believe that they have no agency over their own safety. Overall, much of the cited research finds that the broader social forces influencing risk perception outside of the workplace (especially on roadways) also influence attitudes that can cause workers to take risks on the job.



Campbell Award winner **The Dow Chemical Company** has a Corporate Risk Management group to identify and manage unforeseen risks in all of its operations. Such groups and other company-wide programs like its “Drive to Zero” campaign communicate to employees that safety is a corporate value, encouraging workers to be more risk aware and less risk tolerant (Dow Chemical, 2010).

**Gulf Petrochemical Industries Company (GPIC)**, a Campbell Award winner, maintains a company intranet for all workers to have direct access to standard operating procedures, standing instructions, and minutes from shift talks. Incident information is routinely shared on bulletin boards and through GPIC's "Safety Matters" newsletter. Having access to this information conveys the message that working safely is within an individual's control and that the company is committed to safety (GPIC, 2008).

Another macro-level factor affecting risk perception and tolerance is enforcement and organizational trust. Research in this area suggests that people are more likely to take risks when they do not believe that there will be sanctions for their high-risk behavior, or when they do not believe that their employing organizations are concerned with their safety. In the workplace, this means that workers who trust that management is committed to employee safety and health are less likely to take risks and more likely to adhere to the employer's safety contract (Ford & Tetrick, 2011; Hambach et al., 2011). Transportation safety researchers show how enforcement is tied to risk taking, finding that young drivers take risks near railway crossings (Davey et al., 2008) or speed or run red lights (Evan et al., 2009; Fleiter et al., 2009; Porter & Berry, 2001) because they believed the probability of punishment for unsafe behavior was low and that penalties would not be delivered expediently.

Several studies in transportation safety have shown that more immediate enforcement of traffic safety laws reduces the incidence of high-risk behavior. For example, Nichols et al. (2014) found that seat belt use increased from 11% in 1979 to 86% in 2012 due to primary enforcement laws and increased fines. A study on distracted driving found that high-visibility enforcement on the part of local police forces resulted in a 45% average decrease in drivers using cell phones and a 52% average decrease in texting while driving (Cosgrove et al., 2011). Increased enforcement and swifter consequences for unsafe driving tends to decrease risk-taking behavior.

In addition to trusting that there will be consequences for behaving unsafely, workers need to have faith in the credibility of those communicating safety messages in order to take proper precautions when working (Fischhoff, 1995; Weyman & Kelly, 1999). Employees also need to trust that the organization provides reliable and relevant safety information in order to access and use that knowledge. Perceiving that safety information is not readily available is associated with lower safety efficacy and lower levels of compliance (Real, 2008).

**Meso-level Factors** Peer or community pressure is a meso-level factor influencing how people perceive and tolerate risk. Stress from peers both within and outside the workplace can cause people to take risks that go against their better judgment. For instance, Davey et al. (2008) found that young drivers habitually drive around railway crossing barriers – despite individually believing such actions to be dangerous – because the perception of the community and peers was that such behavior was acceptable. Teens who are exposed to the unsafe driving habits of friends, siblings and parents are more likely to view these behaviors as not high-risk (Sarkar & Andreas, 2004).

The likelihood of a crash and a fatality resulting from a motor vehicle accident increases when a teen driver is accompanied by peer passengers (Chen et al., 2000; Preusser et al., 1998), often because cars are important modes of teen socialization (Shope & Bingham, 2008; Williams, 2003). When adolescents drive with peers, they are constantly trying to maintain and negotiate peer relationships, which make them susceptible to high-risk actions, such as speeding to overtake a car at a peer's request or turning up the volume of music (Allen & Brown, 2008). The desire to please peers often supersedes commitment to safety. Adolescents thus engage in high-risk behavior not only because they perceive less risk, but also because they are focused on their personal image in front of their friends (Goldberg et al., 2002; Keating & Halpern-Felsher, 2008; Halpern-Felsher et al., 2004).

In workplaces, new employees may start taking unsafe shortcuts while performing job tasks because other more seasoned employees are doing so. While a new worker may initially perceive these shortcuts as dangerous, the desire to conform to group activities is strong, even if those activities are high-risk (Cooper, 2003; Harding & Eiser, 1984). Choudry and Fang (2008) observed similar effects of peer pressure in subcontracted workers who chose not to wear personal protective equipment to avoid teasing and harassment from coworkers. Marsh (2012), a recent speaker at the Campbell Institute Symposium, notes that new employees or contractors will rarely "swim against the tide" (9) if the majority of experienced workers behave unsafely.

**Micro-level Factors** A micro-level factor affecting risk tolerance is an individual's level of knowledge regarding a situation. Those who are less informed of a situation are less likely to take risks, while those with more knowledge are more likely to have higher levels of risk tolerance. The caveat here is that this refers only to the individual's own perception of knowledge, which may not be an actual objective assessment. Illustrating this point, Huang et al. (2013) found that survey participants with a perceived higher knowledge



of ecological hazards tended to have a higher risk tolerance for those hazards than those who professed to have little to no knowledge of ecological hazards. Workers in a chemical plant were loath to wear personal protective equipment because they believed they already had an appropriate perception of risk (Venero & Montanari, 2007). Those workers who believe they are fully informed of work tasks are more likely to take risks because of this perceived knowledge. The feeling of personal control over a situation can lessen anxiety and cause a worker to become more relaxed toward engaging in unsafe behaviors (Weyman & Kelly, 1999).

Optimism bias is another concept that is frequently cited in research on risk and is another micro-level factor influencing risk perception. Optimism bias is a person's tendency to believe that a negative event is less likely to occur to him/her than other people, and the person's perception that s/he is more adept at averting injury should a negative event occur (Weinstein, 1984). In a study of beach safety, those who took more risks and had higher risk tolerance levels were more likely to (1) underestimate the severity of an event and one's vulnerability to the threat, and (2) overestimate the efficacy of protective measures and one's own ability to cope with risk (McCool et al., 2009). In occupational safety, overconfident workers minimize potential threats, often underestimating the risk associated with a job 20-30% of the time (Cooper, 2003).

## Theories related to risk perception and risk tolerance

**Protection Motivation Theory** Of the many theories related to explaining risk perceptions and risk tolerance, protection motivation theory (PMT) is one of the most cited. According to this theory, people are more likely to protect themselves when they anticipate negative consequences, have the desire to avoid them and feel they have the ability to take preventive measures. Some may recognize PMT as having similarities to the health belief model (Becker & Maiman, 1975), which argues that people weigh factors such as the severity of the threat, their personal vulnerability, and the possible benefits of protective actions before choosing whether or not to take a risk. Overall, PMT postulates that there is a relationship between risk perception and injuries and incidents, and that people take protective action when they are motivated and have the agency to do so. For example, Sheeran et al. (2013) found that enhancing the elements of risk appraisal (such as risk perception and perceived severity) has a combined positive effect on changing intentions and behavior toward safety.

DeJoy (1996) points out that deciding to take protective actions in the workplace is a process. Workers weigh their response efficacy and self-efficacy (i.e. sense of agency) against the possible costs incurred. Use of personal protective equipment and other protective actions tend to increase as these behaviors become normalized and habituated, and also as workers realize that they can take action to put safety in their own hands.

According to protection motivation theory, risk perception and use of personal protective equipment increase when workers have reason for concern, oftentimes due to a previous incident. For instance, offshore oil workers who had experienced an incident in the past two years felt less safe and had a heightened perception of work task hazards than those who had not experienced an incident (Mearns et al., 1998). Gucer et al. (2003) found that workers were more likely to express concern about hazardous materials and workplace air quality if they had previously experienced an occupational injury. In both these cases, workers' concerns and motivations to protect themselves were heightened because of first-hand experiences of incidents or injuries.

Protection motivation theory has been used to focus safety campaigns and has been shown to be more effective than other methods at decreasing young adults' intentions to speed while driving (Glendon & Walker, 2013). Campaign messages derived from PMT were based on raising awareness of speeding's consequences and increasing young drivers' sense of vulnerability and self-efficacy (e.g. being able to respond to peer pressure by driving within the speed limit). People may be less tolerant of risks imposed on them by others than those risks they choose to take for themselves, which implies that helping people recognize the consequences their actions could impose on others is one way to lead them away from high-risk behavior and be motivated to protect themselves and others. In general, PMT states that being motivated to protect oneself requires not only adequate risk perception, but also the tools and skills to take preventive action. Those who are more likely to take risks tend to be less risk aware and lack the self-efficacy or agency to protect themselves.



Sometimes pressure comes not from peers, but from management. Usrey (2012) of **Predictive Solutions**, a Campbell Institute member, notes that too many "all safe" inspections may not only be a result of workers not recognizing hazards, but also observers who underreport for fear of reprisal or being perceived as poor workers. This type of negative pressure from the top can result in employees continuing to allow others (and themselves) to take risks in the workplace.

Stricoff (2013) of **BST**, a Campbell Institute member, refers to habituated action as “cognitive bias,” noting that workers are more likely to make poor judgments about risk if they have performed a job many times without an incident. Workers can become convinced that their way of performing a job is the “correct” way, even if it is inconsistent with proper work orders.

**Risk Compensation/Risk Homeostasis Theory** Risk compensation or risk homeostasis is another theory explaining why individuals take risks. This theory states that people tend to take more risks when they feel a greater sense of security. In other words, individuals adjust their level of risk-taking behavior depending on the safety measures that are in place (Wilde, 1994). Most of the research on risk compensation theory is focused on transportation safety. Some researchers argue that adding safety features to cars (e.g. air bags, anti-lock brakes, seatbelts and warning systems) actually encourages people to abandon their defensive driving skills because they feel adequately protected by the vehicle. Transportation safety experiments have shown that presence of anti-lock brakes and wearing seatbelts encourages drivers to increase speed and shorten following distance (Aschenbrenner & Biehl, 1994; Janssen, 1994).

Other researchers, however, have found little to no support for risk compensation theory, which remains highly contested. One study found that nearly 90% of the reduction in traffic fatalities from 1964 to 1990 was due to seat belt and drunk driving laws, which seems to rule out the argument that people drive more recklessly when they are buckled up (Robertson, 1998). Robertson and Pless (2002) argue that individuals simply do not have enough knowledge, ability or attention to adjust their behavior to maintain a constant level of risk.

Support for risk compensation theory can be found in non-transportation research. For example, children were observed to navigate an obstacle course more quickly and recklessly (tripping, falling, hitting objects) when wearing a helmet and wrist guards than when not wearing this safety equipment (Morrongiello et al., 2007). In the field of occupational research, Bridger & Freidberg (1999) found that workers wearing an abdominal belt and practicing a squat lifting technique often overestimated the amount of weight that was safe to lift because they believed they were better protected with these measures. Loggers also reported that they increased their work speed, anticipated fewer hazards, and become bolder and more careless when wearing personal protective gear (Klen, 1997). Although risk compensation theory is disputed, there appears to be some non-transportation related research suggesting that it is still valid in predicting some forms of risk behavior.

**Situated Rationality Theory** Situated rationality theory makes the argument that it is erroneous to presume that safe behaviors are inherently rational and high-risk behaviors are inherently irrational. In other words, there is likely a rational justification for why people choose to take risks that is more explanatory than assuming that a risk-taker is simply “crazy” or thrill-seeking. For instance, individuals choose to sunbathe outdoors or use tanning salons despite the risk of skin cancer to enhance their body image (Cafri et al., 2008). Individuals may also engage in unprotected sex with people they know to be drug users or HIV-positive to show trust in their partner and demonstrate “real love” (Rhodes, 1997). Additionally, even the so-called “thrill seekers” tend to know more about the consequences of their actions and the safeguards in place, so a risk that looks unacceptable to the uninformed is actually being well managed.

If the reward of risk taking is too great, it’s often considered “rational” to take risks. A teen may drive unsafely to maintain status among peers, or a person could decide that being on time to an appointment outweighs the risk of unsafe driving (Keating & Halpern-Felsher, 2008). In occupational safety, workers may not wear personal protective equipment because it is more comfortable or convenient (Hambach et al., 2011; Venero & Montanari, 2007) and may not adhere to safe work procedures in order to complete work more efficiently (Slappendal et al., 1993). As Finucane et al. (2000) note, the greater the perceived benefit of an activity, the lower the perceived risk.

Certain aspects of situated rationality theory are connected to the concept of peer and community pressure. Taking risks in the workplace is often justified by workers who are trying to “save face” in front of coworkers or who want to impress supervisors. Also, business structures and embedded production systems tend to reward unsafe behavior because of the potential gains in compensation, output, and recognition. Choudry and Fang (2008) found that Chinese workers often took more risks in hopes that their gains in efficiency would get noticed by supervisors. These workers also noted that being paid bonuses for productivity encouraged them to work less safely, and that taking risks made them appear “tough.” Mullen (2004) also found that workers routinely operated without protective gloves in order to be seen as “macho.” Some female workers lifted more weight than the job required to be viewed as competent or strong in the eyes of male coworkers. Overall, workers of both genders were concerned that appearing less tough, strong or competent jeopardized their good position in the company.

Situated rationality theory is related in several ways to the theory of planned behavior (Ajzen, 1985; Ajzen & Fishbein, 1980). This theory looks at the various social, environmental and psychological factors that influence a person's intent to engage in high-risk behavior. A person takes into account not only his/her own attitudes towards an action, but also the collective attitudes and subjective norms of peers regarding the action. These attitudes may serve as justification and rationale for taking a risk, especially if risk perception is low and the potential rewards (e.g. recognition from peers or superiors) are great.

**Habituated Action Theory** Habituated action theory argues that engaging in high-risk behavior many times without a negative outcome often decreases the perceived risk associated with this behavior. Those who repeatedly perform a high-risk action without an adverse consequence eventually become desensitized to the risk (Kasperson et al., 1988; Weyman & Kelly, 1999). For example, the risk of overdose from injecting heroin is just “an everyday thing” that users accept as part of their habit (Rhodes, 1997). In their study of attachment to cell phones, Weller et al. (2013) found that those who habitually used a cell phone while driving had a lower risk perception than those who had a lower proportion of trips taken while using a cell phone.

These studies show that risk taking can lead to a vicious cycle of more dangerous behavior if negative consequences aren't swiftly realized. Risk perception continues to decrease and risk tolerance continues to increase in this cycle. As Rhodes (1997) states, “Behaviors which are habitual do not demand risk assessment or calculation for their doing; they are simply done” (217).

**Social Action Theory** Social action theory has many applications, but when it comes to risk, this theory states that people take risks because of peer pressure or a general community perception that an activity is low risk. A person could be persuaded to engage in unsafe behavior if “everyone else is doing it” or the community at large doesn't perceive an action to be unsafe. Social action theory also states that the social meaning attached to high-risk behaviors (e.g. “cool” or “manly”) is something that can drive and motivate people to engage in them.

Propensity towards risk can be affected by coworkers' expectations. Individuals conform to group norms to avoid sanctions (e.g. teasing, bullying, being labeled “wimpy”) and start to identify with the group and accept group perceptions and behavior (Cooper, 2003; Harding & Eiser, 1984). This tendency to conform can have positive outcomes when a work group or organization has a strong culture of safety. For instance, workers who have more positive safety interactions with coworkers through safety conversations and rewards for safe behavior tend to have more positive perceptions of safety and therefore perform work more safely (Mullen, 2004).

The negative consequences of social conformity, however, are equally if not more prevalent in studies on risk taking. For example, connections to schoolmates who engage in cigarette smoking, underage alcohol use and unprotected sex significantly increase a teenager's likelihood of engaging in these activities (McNeely & Falci, 2004). Among young people, the popularity of video games and films featuring reckless driving hampers the effectiveness of safe driving messages, promoting unsafe driving as “cool, youthful, and fun” (Keating & Halpern-Felsher, 2008:276). Conformity to the social expectations of peers and the larger community often leads to more, rather than less, risk-taking behavior.

**Social Control Theory** Like social action theory, social control theory has many applications that go beyond the realm of safety and risk reduction. Social control theory was first introduced by Hirschi (1969) and states that connectedness to organizations promotes behavior conformity, which can reduce the probability of high-risk behavior. The research in this area shows that an individual's connection to and affiliation with schools or workplaces has a positive influence on risk perception. In a review of educational connectedness and engagement, school connectedness was an important factor in preventing youth from engaging in risk-taking behaviors, such as smoking, alcohol and marijuana use, and riding with impaired drivers (Chapman et al., 2013). Adolescents who perceive that their schoolteachers are fair, caring and supportive are less likely to smoke cigarettes, drink to the point of getting drunk, have unprotected sex, or attempt suicide (McNeely & Falci, 2004).

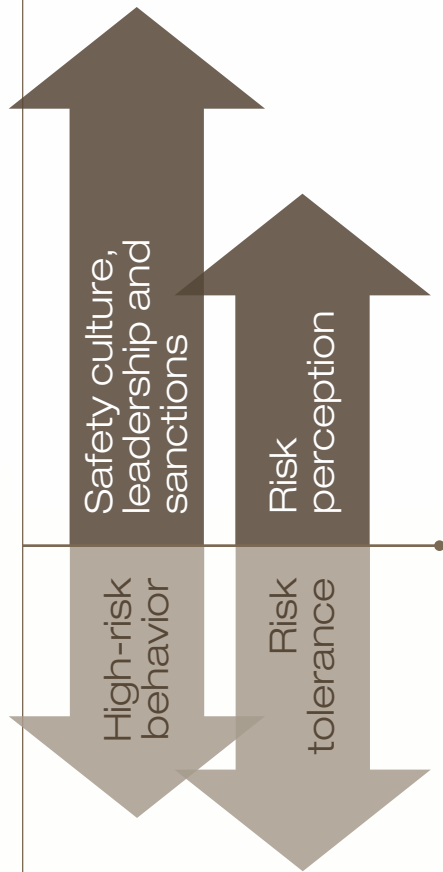
Employee engagement through volunteer or safety programs tends to raise risk awareness and reduce risk taking in the workplace. Being able to participate in hazard identification and contribute to workplace safety improvement builds affiliation with an organization and leads to safer work practices (Clarke & Ward, 2006; Neal et al., 2000).



**DuPont**, a Campbell Award winner, found that employee involvement in safety management boosted morale and reduced the recordable rate at a Georgia-Pacific site by nearly 90% in seven years. Specific auditing sessions that enlisted the help of employees increased their risk awareness and emphasized their role in keeping the workplace safe (DuPont, 2005). Another Campbell Award winner, **Firmenich**, involves employees and line management in risk assessments to identify hazards and properly assess risk according to the hierarchy of controls. This training ensures that high-risks are given top priority and that corrective actions are implemented quickly (Firmenich, 2012).



Organizational identification, or a connection to organizational goals and a collective work identity, was associated with fewer occupational hazards and greater safety participation. Employees with more organizational identification were more likely to encourage coworkers to follow safe work procedures and take action to stop safety violations (Ford & Tetrick, 2011). Ford and Tetrick (2011) also found that psychological empowerment and organizational identification were tied to use of protective equipment when supervisors communicated safety as a top priority. Lastly, Garcia et al. (2004) found that safety climate scores were highly correlated with worker compliance with safety rules and the reduced frequency of deliberate exposure to occupational risks.



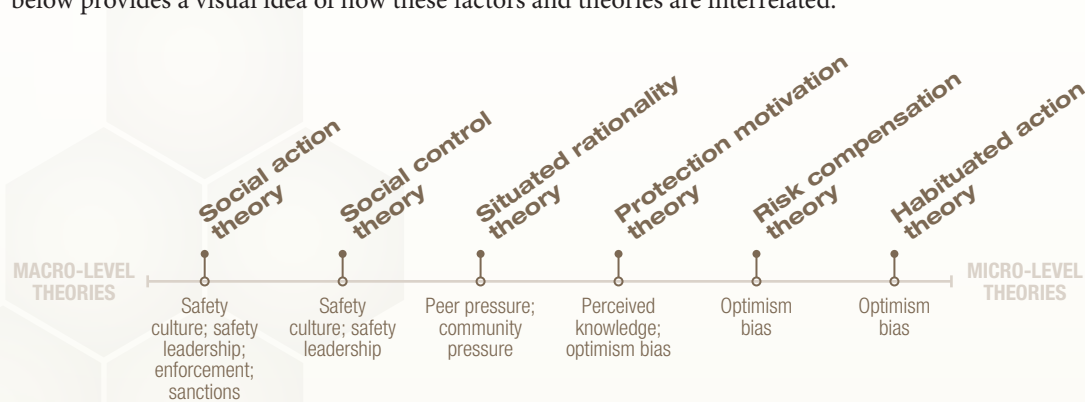
This paper and the examples from Campbell Institute Member companies present a starting point for how to approach risk in your company. Practical outcomes and recommendations include:

- ✓ Analyzing manufacturing and process designs to reduce hazards and avoid imposing risks on current and future workers
- ✓ Assessing management system approaches to engage leadership in raising risk perception and lowering risk tolerance
- ✓ Rethinking how work performance is measured to eliminate workers from taking risks on the job.

Risk managers at **Chevron**, a Campbell Institute Member, have summarized the impact of each theory into the following integrated model. In short, as safety culture, leadership and sanctions increase, risk perception is heightened, risk tolerance decreases and high-risk behavior declines.

## Conclusion: Connections among factors and theories

From this review of the literature, it appears that several of the factors and theories related to risk perception and risk tolerance have overlapping ideas and concepts. The diagram below provides a visual idea of how these factors and theories are interrelated.



Just as the factors related to risk perception can be classified as macro-level (institutional) or micro-level (individual), so can the theories explaining risk perception and risk tolerance. As may be expected, the micro-level factors are associated with the individual-level theories and the macro-level factors are more closely associated with broader institutional-level theories.

Social action theory and social control theory can be labeled as macro- or institutional-level theories because the main impetus for a person to take a risk comes from larger societal forces, such as the lack of a positive safety culture in a community or workplace and the absence of strong safety leadership from parents, teachers or work supervisors. Risk-taking can also stem from the lax enforcement of rules and weak sanctions for unsafe behavior, as well as from the lack of strong positive connections to a school or workplace.

In situated rationality theory, an individual makes a personal decision to engage in high-risk behavior after deeming that the circumstances justify such behavior. Sometimes people choose to take risks in order to avoid losing status in front of peers or coworkers or to conform to a societal idea of what is “strong,” “cool” or “competent.” In this sense, situated rationality theory occupies a middle area in between institutional and individual level theories.

Protection motivation theory, risk compensation theory, and habituated action theory are connected at the individual level through optimism bias. In these theories, people who take risks feel adequately shielded from harmful consequences because they overestimate the effectiveness of protective systems or equipment, underestimate their personal susceptibility to harm or are lured into a false sense of security because of repeated high-risk behavior without an adverse incident.

Each of these theories and related concepts has their merits, and as demonstrated above, many theories are not as disparate as their labels suggest. It could be argued that some of these theories explain risk taking in only slightly different ways and that the originators of these theories would most likely agree with each other on key points. It's apparent that campaigns and programs aimed at increasing risk perception and reducing risk tolerance should attempt to target all levels, from institutions (macro-level) to the individual (micro-level). Understanding the subtle ways in which sociological and psychological forces interact to encourage or suppress risk-taking behavior could aid significantly in creating messaging and programs to make communities and workplaces safer.

## Recommendations for future research

This review of the concepts and theories surrounding risk perception is meant to provide valuable information for understanding and managing risk inside and outside the workplace, but also reveals some areas for future investigation and research. Further study could provide a critical analysis of risk perception factors and theories to determine which are most salient for reducing risk tolerance and encouraging safer behavior. Future research could attempt to answer questions of interest, such as do macro-, meso-, or micro-level strategies work best in conjunction or separately? Does one type of strategy have a more positive effect sooner? When resources are limited, which factor should a company focus on first? Research to answer such questions can significantly expand the knowledge base regarding risk perception and provide more practical recommendations for creating campaigns to strengthen community and workplace safety programs.



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Joy Inouye

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#### Campbell Institute

NATIONAL SAFETY COUNCIL

CALL +1-630-775-2283

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