

The Influence of Individual Cultural Values on Construction Workers' Risk Perception

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The construction industry is known for its high rate of occupational death and injuries worldwide. Despite implementation of several injury-prevention practices, workers still suffer from a high rate of injuries. A large portion of these injuries can be attributed to workers' misperception of a hazard. Due to this issue's importance, several studies attempted to identify factors affecting workers' risk perception. One of the variables that is suggested to have a significant impact on workers' perception is individual cultural values. Therefore, this study attempts to empirically measure the impact of individual cultural values on the risk perception of construction workers. A questionnaire was developed and distributed to measure both the cultural dimensions and risk perception of participants. The questionnaire was filled out by 44 undergraduate students from the University of Nebraska-Lincoln; these students had experience in the construction industry. The collected data was scrutinized by using several statistical methods. The results indicated that people with higher uncertainty avoidance and collectivism assign lower probabilities to low-impact consequences such as first aid or medical case, especially for fall hazards. On the other hand, those with a larger masculinity index tend to underestimate the probability of high-impact consequences such as fatality compared to those with lower masculinity. This study helps to shed light on some of the reasons behind the unsafe behaviors of construction workers that lead to accidents. The results can also benefit firms with diverse workforces so that they can provide culturally sensitive training programs.

Keywords: Construction safety; Individual cultural values; Risk perception

Introduction

The number of work-related fatalities in the United States construction industry grew from 9.1 fatal occupational injuries per 100,000 full-time equivalent workers in 2011 to 9.7 in 2013 (BLS 2011, 2013). Despite implementation of numerous injury prevention programs, the disproportional and increasing rate of injuries has placed the construction industry at the top of the list of dangerous industries in the United States (BLS, 2013). Although the presence of heavy equipment and dangerous tools as well as the boundless amount of manual work significantly contribute to accident occurrence, the risk-taking behavior of workers is identified as the main source of work-related accidents at construction sites (Geller, 1996).

The extent to which workers accept risk depends on how significant they perceive it to be. Therefore, more accurate risk perception could discourage workers from executing actions that correspond with unjustified risk, and it is clear that identification of factors influencing workers' risk perception is of the utmost importance. One variable that impacts risk perception is national culture, a factor that becomes more salient given the growing workforce diversity in the construction sector (Johnston and Packer, 1987). Such varied perspectives about risk have resulted in an unbalanced rate of injuries across different ethnicities (Canales et al., 2009).

Some cross-cultural studies suggest that culture has an impact on risk-taking behavior (Mearns and Yule, 2009). These studies contributed significantly to the body of knowledge regarding the relationship between national culture and risk perception. They are limited, however, because they did not measure cultural dimensions at the individual level. Measuring culture at the individual level would place the focus on individual values rather than national values and would enable researchers to predict workers' behavior based on individual differences.

Therefore, the goal of the current study is to empirically measure the impact of individual cultural values on risk perception at the individual level. The findings of this study could help practitioners link individual cultural values with workers' risk perception and, consequently, their behavior. The paper consists of three main parts: 1) a brief literature review regarding the concept, construct, and measurement of culture; 2) the methodology of data collection, culture and risk-perception measurements, and the appropriate statistical-test selection and analyses; and 3) the results of the study along with the conclusions and practical applications.

Literature review

Role of culture in dissimilar behaviors

Previous studies have shown that national culture impacts people's behavior in several ways: performance of complex tasks (Horie, et al., 2005); beliefs about the importance of production compared to safety (Mearns et al., 2004); and feedback about the key characteristics of leadership (Dorfman and Howell, 1988). Numerous other examples indicate how cultural differences can impact a person's decision making and subsequent actions in the presence of various social phenomena (Clark, 1990; Lynn, 1982; Horie et al., 2005; Mahalingam and Levitt, 2007; Mohamed et al., 2009; Mearns and Yule, 2009; Soares et al., 2007).

Culture is defined as shared experience, beliefs, values, attitudes, religion, and conception of the world accumulated through one's life and transmitted from generation to generation (Hofstede, 1980). According to Hofstede, culture consists of "values as desirable" not "values as desired" (Hofstede, 1980). These latent values are the building blocks of culture, differ from one culture to another one, and could play a key role in understanding dissimilar perceptions and behaviors across ethnic groups and nations. However, studying culture is quite challenging, since the concept is all-pervading and is not easy to manipulate or disentangle. The complexity and elusiveness of culture has forced some researchers to break culture into its fundamental constructs.

Extracting cultural constructs

Previous attempts to extract cultural constructs can be categorized as theoretical or empirical. Some scholars attempted to theoretically derive universally shared dimensions from the context of culture (Kluckhohn and Strodtbeck, 1961; Lynn, 1982; Inkeles and Levinson, 1969). Perhaps one of the first theoretical attempts to delimit and conceptualize culture was made by Inkeles and Levinson (1969). Based on phenomenologically individual traits, they suggested that by sampling from the population, a cultural model could be tested and interpreted (Inkeles and Levinson, 1969); this approach was widely accepted as the beginning of the dimensionalization of culture (Clark, 1990). On the other hand, other scholars have focused on finding cultural dimensions empirically (Hofstede, 1980; Schwartz, 1994; Triandis, 1995). The groundbreaking work of Greet Hofstede featured 88,000 respondents across 66 countries and was one of the most successful attempts to dimensionalize culture (Hofstede, 1980). This empirical approach toward culture measurement resulted in four dimensions: 1) power distance, 2) uncertainty avoidance, 3) individualism, and 4) masculinity & femininity. Notably, these empirical dimensions had an interesting overlap with Inkeles' theoretical dimensions (Hofstede, 1980). In 1987, Chinese Cultural Connections executed another extensive empirical research study to find out about Chinese culture. They found that except for one dimension, confusion dynamic, all other dimensions are in line with Hofstede's (Chinese Cultural Connections, 1987). Later, Hofstede adopted confusion dynamic as the fifth dimension and called it *long-term orientation* (Hofstede and Hofstede, 2005).

The *power distance* index (PD) measures the distribution of power in a society—"the extent to which the less powerful members of organizations and institutions accept and expect that power is distributed unequally" (Hofstede and Hofstede, 2005). *Uncertainty avoidance* (UA) measures a society's proneness to uncertainty and ambiguity. Societies with a high UAI (Uncertainty Avoidance Index) will stick to their principles while those of low UAI will "maintain a more relaxed attitude in which practice counts more than principles" (Hofstede and Hofstede, 2005). *Individualism* (IND) represents the degree to which individuals in a society care only about themselves or their immediate families rather than others in the society. In these societies, connections between individuals are weak, and the integration of an individual into the group will not be well established. *Collectivism* (COL), on the other hand, opposes individualism and stands for the degree to which the individuals prioritize the whole group over each member of the group. *Masculinity* (MAS) refers to the inclination in a society toward "achievement, heroism, assertiveness and material rewards for success" (Hofstede and Hofstede, 2005). On the other hand, *femininity* signifies the degree of collectivism, cooperation, courtesy and quality of life. *Long-term orientation* (LT) stands for the degree of thrift, persistence, and variability for the future. Consequently, short-term-orientated societies are more stable in their traditions and are not willing to change dramatically to be prepared for the future. According to Hofstede, cultural dimensions are constant constructs across nations by which certain characteristics of those nations can be determined.

Following the movement towards conceptualization and measurement of culture, other scholars have proposed various cultural dimensions (Dorfman and Howell, 1998; Schwartz, 1994; Triandis, 1995). Notably, Hofstede's cultural dimensions seem to encompass many of these dimensions. Soares et al. (2007) compared Hofstede's dimensions to those presented by the above-mentioned scholars and highlighted the universality and comprehensiveness of Hofstede's five dimensions—namely, that his dimensions have an excellent overlap with the others'.

Measuring culture at the individual level

Although Hofstede's cultural model has gained extensive popularity, many criticisms have been raised regarding its inability to capture cultural homogeneity, the impact of political influences on national culture changes, and its representation of a whole nation based on one organization (Jones, 2007). One of the main debates about Hofstede's cultural model centers on its failure to measure cultural dimensions at the individual level (Hofstede, 1980). Measuring culture at the individual level has a tremendous effect on cross-cultural studies, since focusing on individual values rather than national values makes determination of the individual's anticipated behavior more accurate (Lenartowicz and Roth, 1999). Accordingly, Dorfman and Howell (1988) pointed out the significance of individual-level analysis in identifying and specifying "relationships among organizational variables that are sensitive to certain cultural differences." They argued the ambiguity of Hofstede's ecological meaningfulness and the inadequacy of the model's efficiency at micro-level analysis. These debates encouraged other scholars to view culture from the micro-level perspective.

The early groups of scientists who tried to address this knowledge gap were anthropologists who attempted to present a cultural orientation framework capable of measuring cultural dimensions at the individual level (Kluckhohn et al., 1961). In 2010, Fischer et al. (2010) investigated the isomorphism of individual and country levels of cultural value constructs presented by Schwartz. Their findings demonstrated substantial similarities between the two levels of cultural constructs and showed that the value scores, especially the individualism index, could be utilized at the individual level. Using Hofstede's cultural dimensions, Yoo et al. (2011) developed their own survey, the Individual Cultural Value Scale (CVSCALE), by selecting and modifying questions from previous studies. They claimed it was capable of eliminating the deficiencies of Hofstede's cultural questionnaire and measuring an individual's cultural indices instead. They tested CVSCALE on American and South Korean students and concluded that not only is the reliability of each dimension acceptable, but also, according to the sufficient invariance of the factor loadings, these national dimensions indices can be used for cross-cultural comparisons. Since then, CVSCALE has been applied in several cross-cultural studies (Soares et al., 2007; Paul et al., 2006; Smith, 2004; Kwok and Uncles, 2005; Alrawi and Jaber, 2008; Chan et al., 2010). In one recent cross-cultural study at the individual level, Mazanec et al., (2015) used CVSCALE to collect data from a large sample size (n>500) and found that CVSCALE is reasonably appropriate for measuring Hofstede's cultural dimensions at the individual level. Because CVSCALE has been shown to be reliable in measuring national culture dimensions at the individual level, we used this questionnaire in this study.

Risk perception and culture

Risk perception is defined as an internal conceptualization of an uncertainty that helps people evaluate a situation and execute an action (Sjoberg and Rundmo, 2004). Considering that misperception of risk could lead to an accident (Hallowell, 2010), several studies have been conducted to identify variables that impact construction workers' risk perception (Rundmo, 1995 and 1996). Because the symbols and values of a group or society impact risk perception (Weinstein 1980), one factor claimed to affect workers' risk perception is national culture (Weber and Hsee, 2000; Mahalingam and Levitt, 2007). While previous studies explored the impact of national culture on workers' risk perception using Hofstede's cultural model (Mearns and Yule, 2009; Mohamed et al., 2009), no study has investigated the relationship between national cultural dimensions at the individual level and risk perception. Therefore, in the current study, we attempted to measure the national cultural dimension of individual students at the University of Nebraska-Lincoln (UNL) using CVSCALE and then compared the students' various levels of risk perception.

Method


Sample

Study participants were recruited from undergraduate students in the construction management and civil engineering departments at UNL, a large number of whom have construction work experience. In total, 44 students voluntarily participated in the study. Of these, 68 percent of participants had more than one year of work experience at construction sites, 10 percent had passed the 10-hour OSHA training program, and 25 percent had completed other safety training programs. Thirty percent of the participants had experienced at least some kind of injury at a construction site, and only 15 percent of those had injuries requiring medical care or more extensive treatment. Overall, 16 percent of the participants had witnessed a severe injury incident at a construction site.

Measures

A self-administered quantitative questionnaire was developed and distributed to the participants to measure their risk perceptions and cultural dimensions. The questionnaire included three parts. The first part was developed to obtain demographic information from the participants, with questions about gender, ethnicity, country of birth, native language, highest educational level, annual income, employment history, and experience in the construction industry. In the second part, the CVSCALE statements were presented to quantitatively calculate the respondents' cultural dimensions at the individual level (Yoo et al., 2011). The respondents were asked to respond to the

statements using a Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree). The final portion of the questionnaire captured the risk perception of the participants. They were shown ten different pictures depicting various hazardous scenarios and instructed to assess the frequency and severity of potential accidents in each picture using the table provided in Figure 1.



		Frequency (once every ...)			
		Week	Month	Year	10 years
Severity	First aid				
	Medical case				
	Lost work time				
	Permanent disablement				
	Fatality				

Figure 1: An example of risk perception collection tool

Scoring

Later we assigned a weighted value to each severity and a different value to each frequency. These weights were adopted from the scale developed by Hallowell and Gambatese (2009) and have been used successfully in quantifying safety risk in several studies (Hallowell et al. 2011; Esmaeili and Hallowell 2013; and Esmaeili et al. 2015). According to this scale, we weighted severity as 32 (first aid), 128 (medical case), 256 (lost work time), 1024 (permanent disability), and 26214 (fatality). Then we assigned frequency values of 1/40 (every week), 1/166.7 (every month), 1/2000 (every year), and 1/20000 (every ten years). We calculated the risk perception an individual participant associated with each picture by multiplying the weighted value of the severity by the corresponding frequency value. We then calculated the mean of all 10 risk perception values to determine the participant's overall measured risk perception. The higher the score, the greater the perception of risk. After collecting all questionnaires, the raw data were tabulated and trimmed. In the trimming process, three students were removed from the study because of incomplete answers to the risk-perception part.

Analysis

The standardized residuals method approach was selected for detecting outliers. This method considers ± 3 Z-scores as the critical values. Using the standardized method, one observation was detected and deleted due to its high Z scores (Stevens, 1984). Next, correlations between the following variables were calculated: power distance, uncertainty avoidance, collectivism, masculinity, long-term orientation, and risk perception. Since some distributions were not normal, instead of using the Pearson-correlation method, we used Kendall's tau correlation technique. Kendall's tau method was developed by Kendall (1938) and does not rely on any assumptions about the distributions of variables. Subsequently, to investigate the impact of each cultural dimension on the respondents' risk perception, the data sets were grouped into two extreme clusters for each cultural dimension. Groups were classified based on the top and bottom 33rd percentile of the cultural dimension values. The risk-perception values provided by respondents were then compared using the Mann Whitney U test. It is worth mentioning that the Mann Whitney U test is robust to the violation of normality and homogeneity of variance.

Results

The results of the correlation analysis are shown in Table 1. There is a positive correlation between participants' assessment of first-aid injury frequency and uncertainty avoidance (0.23, sig. = 0.05). The same trend can be found for medical case and uncertainty avoidance (0.22, sig. = 0.06), medical case and collectivism (0.22, sig. = 0.06), and lost work time and uncertainty avoidance (0.23, sig. = 0.06). It is worth noting that there is a partially significant (sig. = 0.09) negative correlation between masculinity and participants' judgment of the fatality outcome (- 0.20). The results of the Mann Whitney U test are presented in Table 2, including the significant level of mean differences. People higher in uncertainty avoidance and collectivism have higher perceptions about accidents that might lead to medical case injuries. There are some other partially significant differences among other groups: people higher in masculinity have lower perceptions for fatality accidents ($p=0.09$); and people higher in uncertainty avoidance have higher perceptions for lost work time accidents ($p=0.07$).

Table 1. *Kendall rank correlation coefficients*

		Cultural dimension indices ¹					RP ²	Probability of different outcome injuries ³				
		PD	UA	COL	MAS	LT		FA	MC	LWT	PD	FAT
PD	Correlation Coefficient	1.00										
	Sig. (2-t)											
UA	Correlation Coefficient	-	1.00									
	Sig. (2-t)	0.06										
COL	Correlation Coefficient	0.05	0.09	1.00								
	Sig. (2-t)	0.67	0.48									
MAS	Correlation Coefficient	0.13	0.14	-	1.00							
	Sig. (2-t)	0.29	0.26	0.19								
LT	Correlation Coefficient	0.00	-0.13	-	0.08	1.00						
	Sig. (2-t)	0.98	0.28	0.50	0.48							
RP	Correlation Coefficient	-	-0.01	0.07	-0.18	0.13	1.00					
	Sig. (2-t)	0.01	0.94	0.90	0.56	0.11	0.26					
FA	Correlation Coefficient	-	0.23*	0.17	-0.19	-	0.16	1.00				
	Sig. (2-t)	0.11	0.36	0.05	0.16	0.10	0.40	0.16				
MC	Correlation Coefficient	0.08	0.22	0.22	-0.15	-	.427**	.486**	1.00			
	Sig. (2-t)	0.48	0.06	0.06	0.18	0.41	0.00	0.00				
LWT	Correlation Coefficient	-	0.23	-	-0.09	-	.449**	0.21	.359**	1.00		
	Sig. (2-t)	0.07	0.57	0.06	0.73	0.44	0.82	0.00	0.07	0.00		
PD	Correlation Coefficient	0.08	-0.01	0.06	-0.10	0.11	.688**	.233*	.491**	.433**	1.00	
	Sig. (2-t)	0.48	0.93	0.63	0.37	0.37	0.00	0.04	0.00	0.00		
FAT	Correlation Coefficient	0.00	-0.12	0.11	-0.20	0.19	.843**	0.07	.340**	.304**	.584*	1.00
	Sig. (2-t)	0.97	0.33	0.34	0.09	0.12	0.00	0.54	0.00	0.01	0.00	

† Sig. at 0.1 level, * Sig. at 0.05 level, ** Sig. at 0.01 level.

¹PD: Power distance, UA: Uncertainty avoidance, COL: Collectivism, MAS: Masculinity, LT: Long term orientation; ²RP: Risk Perception; ³FA: First aid, MC: Medical case, LWT: Lost work time, PD: Permanent disablement, FAT: Fatality

Table 2. *Results of Mann Whitney U test based on participants' frequency assessment and risk perception of visual hazards*

	Risk perception	First aid	Medical case	Lost work time	Permanent disablement	Fatality
PD ¹	0.48	0.18	0.70	0.32	0.98	0.52
UA	0.94	0.10	0.03*	0.07†	0.79	0.47
COL	0.59	0.12	0.04*	0.66	0.98	0.34
MAS	0.11	0.16	0.25	0.26	0.43	0.09†
LT	0.23	0.55	0.63	0.94	0.26	0.28

* Sig. at 0.05 level; † Sig. at 0.1 level; ¹PD: Power distance, UA: Uncertainty avoidance, COL: Collectivism, MAS: Masculinity, LT: Long term orientation

Finally, we compared the cultural dimensions obtained from this study with those from other studies that used the CVSCALE as a cultural measurement tool. The results are summarized in Table 3. Cultural dimension values of

American students in this study (n=34) are similar to those obtained by Yoo et al., (2011) and Paul et al., (2006), especially with regard to the power distance and masculinity indices, indicating that the sample size used for this study can be considered a good representation of American culture.

Table 3. *Comparison between national cultural dimension indices of the American students in the three studies*

Cultural dimensions	This study N=34	Paul et al. (2006) N=110	Yoo et al. (2011) N=213
Power Distance	2.02	1.72	2.10
Uncertainty Avoidance	4.46	3.61	3.71
Collectivism	3.61	3.19	3.05
Long-Term Orientation	4.31	3.97	3.97
Masculinity	2.51	2.18	2.25

Discussion

The partially significant negative linear relationship between the perceptions of participants regarding the fatal outcomes of hazards and their masculinity dimension index is in line with Mearns and Yule's findings (Mearns and Yule, 2009). According to this study, power distance and masculinity were the only two cultural dimensions that significantly impact risk perception and risk-taking behavior of front-line workers in the global oil and gas industry (Mearns and Yule, 2009). The negative correlation implies that people with higher masculinity perceive less risk of fatality than people with lower masculinity. Therefore, regarding the safety of workers, masculinity could be manifested as a symbol of dignity and encourage workers to execute actions, regardless of the possible negative outcome (Mearns and Yule, 2009). These findings have practical implications for designing more effective injury-prevention practices. Since all of the pictures used to measure risk perception illustrated fall hazards, this research pointed out the importance of masculinity as a prominent predictor of workers' perception of risks associated with fall hazards. By measuring cultural dimensions of workers on a site, safety managers can take proactive actions and provide further training for workers whose masculinity index is higher, thereby increasing these workers' awareness regarding potential hazards. Further research should be conducted to determine whether cultural dimensions have the same impact on workers' perceptions about other types of hazards.

As far as inferential statistics are concerned, one interesting finding of the study is that people with higher uncertainty avoidance assessed the frequency of low-impact injury outcomes (such as first aid or medical case) significantly differently from people with lower uncertainty avoidance. As Hofstede and Hofstede (2005) stated, uncertainty avoidance is the extent to which a society deals with the ambiguity and uncertainty in different situations. Although uncertainty avoidance is not the same as risk avoidance (Hofstede and Hofstede, 2005), in this study, those with a higher uncertainty avoidance value tended to assign higher frequencies to low impact outcomes. On the other hand, people with low and high uncertainty avoidance showed no significant difference in assessing the frequency of severe outcomes, including permanent disability and fatality. A similar pattern can be seen for people with higher collectivism values, who give higher value to low-impact injury outcomes.

There are several implications for these findings. First, they are in line with those of Lesch et al.'s study (2009), which pointed out the effect of uncertainty avoidance as an influential predictor of risk perception. According to Lesch et al. (2009), Chinese people, who have lower uncertainty avoidance levels compared to Americans (Hofstede and Hofstede, 2005), perceive fewer hazards via warning components and signs. Correspondingly, Mohamed et al. (2009) indicated that higher levels of uncertainty avoidance and collectivism indirectly help workers develop higher safety awareness and subsequently safer behaviors. Second, individual cultural values do not impact a person's judgment in assessing high-impact events. The results of the study suggest that all participants consider high-impact events to be infrequent.

Conclusion and Limitations

One of the main concerns in the construction industry is the high rate of injuries and fatalities among construction workers. In response, numerous efforts have been made to investigate the root causes of unsafe behavior. A majority of these studies concluded that the risk perception of the workers is a key factor in unsafe behaviors and, consequently, accident occurrence (Geller, 1996). In addition, national culture has emerged as a significant predictor of humans' decision making (Guess, 2004); however, only a limited number of studies have explored the relationship between national culture dimensions and more specifically, individual cultural values and the risk perception of construction workers. To address this knowledge gap, this study aimed to compare national cultural dimensions at the individual level with the risk perceptions of undergraduate students who had a construction engineering and management background. Academics can be benefitted from the results since it is one of the early

studies in measuring the impact of individual cultural values on safety-risk perception. Furthermore, practitioners can benefit from the results of this study if they use it to develop culturally sensitive safety training programs to optimize the risk perception of a diverse workforce.

Some limitations related to the external and internal validity of this study are worth noting. First, the sample size of the study was smaller in comparison to other research studies, and all participants were from University of Nebraska. Although most of the student participants in this research had had more than one year of experience in the construction industry, field construction workers might have different risk perceptions and attitudes toward safety. To reliably extrapolate the results of the study to the construction industry, larger sample sizes should be collected from construction workers across the country. Second, although measuring risk perception by showing pictures has been used in other studies (Zhang et al, 2015), researchers should be cautious about interpreting results. Instead of asking participants to assess the frequency and severity of potential accidents in a table format, it may be better to conduct face-to-face interviews and capture their perceptions by asking qualitative questions. Despite these limitations, this study departs from the current body of knowledge by measuring the impact of individual cultural values on the risk perception of construction workers and consequently their behavior in a construction site.

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