DEMOGRAPHIC INFLUENCES ON RISK PERCEPTIONS

by

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ABSTRACT

Over the past fifteen years psychologists have empirically investigated how people perceive technological, consumer and natural hazards. The psychometric attitudes to risk being summarized by three factors: "dread", whether the risk is known, and personal exposure to the risk. The results have been used to suggest that certain types of hazards are viewed very differently from other hazards. The purpose of this paper is somewhat different, in that it investigates whether individual demographic characteristics influence psychometric perceptions of risk. This paper makes use of a large, professionally conducted, survey of a wide cross-section of the residents of metropolitan Chicago. One thousand adults were interviewed in a random-digit dial telephone survey, producing a useable dataset of about 800. Data on the three risk factors mentioned above were obtained on 7 point scales for four common hazards: aviation accidents, fires in the home, automobile accidents and stomach cancer. The survey also collected demographic data on respondents' age, schooling, income, sex and race. Regressions were then conducted to relate the demographic characteristics to risk perceptions. Some strong general conclusions can be drawn. The results suggest that women, people with lower levels of schooling and income, younger people, and blacks have more dread of hazards. The exception being age related illnesses which, not unnaturally, are feared by older people. Unlike previous literature we cannot substantiate the argument that these groups of people are less informed about hazards and thus less accepting of them. The most likely leading explanation of the relationship between demographic factors and dread of a hazard is the perceived personal exposure to the hazard. People with greater perceived exposure to a hazard are more fearful.

Keywords: Risk, perceptions, demographics, survey

1. INTRODUCTION

Ever since the seminal writing of Lowrance [1] psychologists have empirically investigated how people perceive technological, consumer and natural hazards (Fischhoff et al., [2]; Slovic et al., [3,4]; Johnson and Tversky, [5]). Previous authors have used their results to conclude that certain types of hazards are viewed very differently from other hazards. The purpose of this paper is somewhat different. It is to observe whether certain subgroups of the population systematically view hazards differently from other subgroups.

Much of the early empirical work in the field of risk perceptions, such as those cited above, were unsuitable for investigating the issue of demographic effects as sample size tended to be under 100, and the respondents were drawn from a narrow band of society. However, later studies were much larger and featured a more diverse range of respondents. Slovic [6] using large samples in Canada and Sweden, and Cutter et al. [7] found that women tended to perceive greater risks from technology than did men. Pilisuk and Acredolo [8] using a random sample of 450 people in California found that greater "concern" for technological risk was shown by ethnic minorities, less educated and poorer people, and by women. On the other hand, Gould et al. [9], using samples of about 500 in each of Connecticut and Arizona, found that education, political leanings and gender had little effect on attitudes to risk. Although they did find that women generally favored more safety related regulations than men; and that higher income and more educated people had generally more pro-safety attitudes.

Pilisuk and Acredolo [8] postulate that wealthier and more educated people tended to better understand the scientific complexities of technological hazards and therefore be more accommodating in accepting them. They also suggest that such people may also have the financial means to insulate themselves from hazards. Gottfried [10] conducted a lengthy review of the literature on the risk perceptions of women and concludes that while there are many economic and sociological hypotheses for why women show greater concern then men, there is a sparse empirical literature to support any hypothesis.

The present study expands on the previous literature by using a large random survey of adults in metropolitan Chicago. The usable sample of about 800 includes a wide diversity of ages, incomes, education, gender and race. 57% of respondents were female and 20% were black. The study considers how respondents view four common hazards using three cognitive psychometric risk dimensions.

2. SURVEY DESIGN AND IMPLEMENTATION

Budgetary considerations limited the scope of this work to (a) only seek information on four hazards, and (b) research only three cognitive psychometric risk dimensions. The four hazards were chosen based on prior evidence from the work of Slovic et al. [3] that these hazards were cognitively viewed as having very different characteristics. The hazards chosen were commercial airplane accidents, fires in the home, automobile accidents and stomach cancer.

The three risk dimensions investigated were: "dread", "unknown", and "personal exposure". These three dimensions were suggested by Slovic et al. [3] based on factor analysis of nine dimensions of risk originally proposed by Lowrance [1]. People appear to have a great "dread" of a hazard when it is catastrophic; if death is a long draw out event (e.g., cancer); if victims are exposed to the hazard involuntarily; and if, when exposed to the hazard, the victim cannot by personal skill or diligence avoid harm. The "unknown" factor is relatively self-explanatory comprising the fact that victims may not observe the hazard when it occurs, do not personally know the risk, or that the probability or consequences of the hazard are not even known to scientists. The "personal exposure" factor is also relatively self-explanatory and represents the relevance of the hazard to the lives of individual respondents. The data on risk perceptions were collected on a 7 point scale, which appears to be a standard approach adopted by the psychologists. The exact wording of the questions will be described when we discuss the results of our analysis in sections 4 through 6 of this paper.

The data for this analysis were collected as part of Northwestern University Survey Laboratory's annual *Chicago Area Survey Project (CASP-91)*. *CASP-91* is a random-digit dial telephone survey of the adult population in Cook, Lake and DuPage counties of northeastern Illinois, which covers the greater part of the City of Chicago and its surrounding suburbs. It is a multi-issue survey gathering information on a large number of issues including quality of life measures, race relations, media performance, political attitudes, and also other topic areas which the faculty of Northwestern University could pay to have included. Additionally, many standard demographic items were included. The questionnaire ran to some 108 questions, of which the questions for this analysis were numbered 42-44, and produced a maximum usable sample size of 1,027.

In addition to administering the questionnaire, the Survey Laboratory also provided advice on the structuring and wording of questions, pre-testing, and data input verification and "cleaning". The survey was conducted in May 1991 using professionally trained and supervised staff. Over 10% of the completed interviews were validated by call-backs to the original respondents. No problems were found during the validation process. Extensive efforts were made to avoid bias by repeat calls to selected telephone numbers (over 20% of selected numbers required over 10 calls to complete the interview) and by training interviewers to minimize the number of refused interviews.

3. ANALYTICAL TECHNIQUE

Two types of analysis were conducted. The first type, which will be described reported on in the next three sections of this paper, looked at variation over individuals for each hazard. There are therefore four regressions for each of the dread, unknown, and personal exposure factors. The following semi-log regression forms were conducted:

$$X = \alpha_0 + ß_1 \ln(AGE) + ß_2 \ln(SCHOOL) + ß_3 \ln(INCOME) + ß_4 MALE + ß_5 BLACK$$

where: X is either the dread, unknown or personal exposure factors

AGE	is the person's age in years
SCHOOL	is the number of years spent in school (all of grade, high, undergraduate and graduate education together)
INCOME	is the mid-point of six bands of annual pre-tax income. These were $5,000, $15,000, $30,000, $50,000, $80,000 and $125,000.
MALE	A dummy variable taking the value 1 for male.
BLACK	A dummy variable taking the value 1 if the respondent was black. (The wording of the questionnaire made it impossible to identify respondents of Hispanic ethnicity.)

Some multicollinearity problems were expected. However, with the exception of a correlation coefficient of -0.44 between SCHOOL and BLACK, other correlations were quite small.

A second type of analysis looked at variations across both individuals and hazards. The methodology used and the results obtained will be described in section 7 of the paper.

4. THE DREAD FACTOR

The first psychometric factor investigated related to the individual's psychological dread for each of the hazards. Of interest to other researchers in the field is that originally the word "dread" was used in this question. However, during the pre-testing (on 50 respondents) it was reported that respondents had great difficulty understanding what the term meant. Therefore, it was decided to use the definition of whether respondents could think about a risk in a calm way or whether they became nervous about it. Although the term "dread" will be used in the description of the results, it is worth noting that this is a term which is widely understood by professionals working in the area, but is not in common usage amongst lay people. The form of this question is shown in figure 1.

The results of the four regressions, one for each of the hazards, are shown in table I. Goodness-of-fit is reasonable for these equations with adjusted r^2 in the range of 0.13 to 0.19. There are also some strong results for individual demographic factors. Blacks have a much higher level of dread for all of the hazards. Lower levels of schooling and higher incomes lead to higher levels of dread. Women also appear to have higher levels of dread for all hazards. Younger people have significantly higher dread of hazards than older people, except for the case of stomach cancer where the effect of age is insignificant. Given that stomach cancer is more prevalent amongst older people this result is not too surprising. In contrast, aviation, fires and auto accidents are a realistic threat to all age groups.

5. THE UNKNOWN FACTOR

The next question attempted to elicit the individual's perceived knowledge of the risk which corresponds to the "unknown" factor described by psychologists. In devising the question we emphasized not only perceived knowledge of the probability of the hazards but also the seriousness of the consequences in the event that the hazard occurs. Following pre-testing it was considered advisable to have "Don't know anything" correspond to the response 1, and "Well informed" to the response 7. This is the reverse of the other questions where the "worse" outcome corresponded to 7. We therefore transformed the data collected by subtracting from 8 in order to form the unknown variable used in the regression analysis.

The results for the regressions conducted on each hazard are shown in table II. In comparison to the dread factor the goodness-of-fit of these regressions is quite poor. The equation on cancer has an adjusted r^2 of 0.08 while for the other risks the adjusted r^2 is a very poor 0.02-0.03. Not only is the explanatory power low, but also no consistent general statements can be made with regard to the demographic variables. What demographic variation there is appears to be more specific to each of the risks, and given the poor explanatory power, strong inferences are difficult to draw. The sole exceptions are that as people get older they appear to become better informed about the risks of stomach cancer; and that blacks think they are better informed, in general, than non-blacks especially about fires in the home and auto accidents.

6. THE PERSONAL EXPOSURE FACTOR

The final question asked for a measure of the individual's subjective probability of being affected by the hazard. The question was phrased so as to elicit the threat felt by the individual and not the individual's opinion about the prevalence of the hazard in society in general. Interviewers were instructed to reinforce this objective. The ordinal risk scale of 1 to 7 was again employed here as we were interested in peoples' relative perceived risk in comparing the hazards rather than observing whether people could state some numerical probability of death (such as 1/10,000).

The results shown in table III have a better goodness-of-fit than the unknown variable but not as good as that for dread. Aviation has an adjusted r^2 of 0.03 while the explanatory power for the other three hazards was in the range 0.08-0.1. There are some consistent conclusions. Blacks feel they are more threatened by the four hazards than non-blacks. Women feel they are personally more threatened than men. Lower incomes are associated with more of a perceived threat from fires and cancer and to a lesser extent aviation accidents. People with less years of schooling feel that cancer is more of a personal threat. With regard to a person’s age, older people feel that they are exposed to a greater extent to cancer but to a lesser extent automobile accidents, fires and aviation accidents.

7. VARIATION ACROSS INDIVIDUALS AND HAZARDS

The second type of analysis was then tried which introduced variation across hazards as well as across individuals. One set of regressions placed all the observations together in a large

pool. The regressions, for each of dread, unknown, and personal exposure, included the demographic variables described above and fixed effects for three of the four hazards. Dummy variables were included that influenced both the slope and the intercept of the demographic variables. Conclusions from this analysis generally mirror those discussed in the preceding sections of this paper, and therefore the table of regression results is omitted for the sake of space.

The pooling of both hazards and individuals also allowed the possibility of correcting for individual response scaling, a common problem in psychometric empirical analysis. That is to say that while two individuals may rank the four hazards identically on the issue of, say, dread, one might anchor his/her response around the number 5 on the 1 - 7 scale, and the other around the number 3. The respondents do this not because the first person feels a heightened dread for all the risks, but because they are unsure where to anchor their answer on the 1 - 7 scale. To make the correction the psychometric variables were manipulated to be the deviation from the respondent's answer to that question for the stomach cancer hazard. Dummy variables were included to represent the effect of the other three hazards on both the intercept and slope of the demographic variables. Clearly this method is not necessary superior to that in the preceding paragraph in that while the scaling problem is removed, some other potentially important information is also removed. That is a person who gives a scores of 6 and 7 for the various hazards probably is more fearful than someone who gives 1 and 2 although this latter analysis treats both as being equivalent. The results of this exercise indicate that this is the case. All the demographic coefficients become statistically insignificant, implying that the effect of demographics is in the scaling of perceptions and not in the relative positioning of the four hazards. Given this rather negative finding, the table of regression results has been omitted to save space.

One reviewer of this paper raised the possibility that the results obtained might not be due to differences in risk perception but rather in how different population sub-groups view mid-point values on the seven point scale employed, given that no wording was used to indicate the meaning of, say, the value 5. However, the fact that the equations dealing with the unknown factor had a very poor performance while the dread and personal exposure equations did not would seem to refute such an argument.

8. DISCUSSION AND CONCLUSIONS

The use of a sample which encompasses a wide cross-section of the population of metropolitan Chicago permits an investigation of the effects of demographics on psychometric measures of risk perception. An initial comment is that 80-90% of the variation in risk perceptions across individuals is a function of a person's character rather than demographic features. However, there are some strong results that suggest there are consistent variations in risk perceptions explained by demographics.

The strongest conclusions emerge with regard to the dread of a hazard; explanatory power of the equations is reasonable and demographic variables are very statistically significant. In general, the results confirm findings in previous literature. Women, people with lower levels of schooling and income, and blacks have more dread of hazards. In general younger people have

higher dread than older people; except in the case of stomach cancer which, not unnaturally, is feared more by older people.

Pilisuk and Acredolo [8] hypothesize that one possible explanation for these results is that the groups mentioned above are less familiar with the technological complexities of the hazards and thus less accepting of risks. The present results suggest that this is not the case. The question which tried to elicit how well informed people were about the risks and seriousness of the various hazards had terrible explanatory power and little consistency in the signs and significance of the demographic variables.

Rather, one should conclude that the most likely leading explanation of the relationship between demographic factors and dread of a hazard is the perceived personal exposure to the hazard. Women, blacks, the young, and those with lower levels of income and schooling feel both heightened personal exposure to risks and have more dread of them.

It is instructive to compare the perceived variation in exposure by the different groups with statistical probabilities of the threat posed by the hazards to different groups of people. In some cases, heightened perceived threat is substantiated by reality. A casual perusal of the Chicago newspapers would suggest that blacks correctly perceive that a disproportionate number of fatal household fires occur in minority neighborhoods. However, this is not always the case. The typical victim of a commercial aviation accident is white, male, middle-aged and has a good income, although such people have a lower perceived exposure.

From the point of view of "producers" of technological risk, who wish to reduce dread and thus promote acceptability of a hazard, there would appear to be several practical implications. Higher income, older people, and men appear to believe that they are less exposed to a risk and therefore less fearful even when statistically they are the actually more exposed. Thus airlines, and other "producers", who primarily cater to these sub-groups of people will find that the consumers of their "products" will be more accepting of the risks. However, the opposite is true for women and blacks who feel greater exposure and fear even when statistically they are less exposed to danger. This result cannot be attributed to lack of perceived knowledge of hazards by these groups; if anything blacks feel more informed about the probability and consequences of hazards. Producers of technologically hazardous products that are primarily consumed by women or blacks can expect that their product will be viewed more skeptically, and may require more intensive marketing and better risk communication to improve product acceptability.

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TABLE I

ANALYSIS OF DREAD FOR EACH HAZARD

(standard errors in parentheses)

	AVIATION	HOME FIRES	AUTOS	CANCER
Constant	12.150***	11.516***	14.102***	9.820***
	(1.429)	(1.389)	(1.241)	(1.523)
ln(AGE)	- 0.685***	- 0.339*	- 1.119***	0.190
	(0.206)	(0.200)	(0.178)	(0.219)
ln(SCHOOL)	- 0.812**	- 0.900**	- 0.977***	- 1.373***
	(0.383)	(0.372)	(0.332)	(0.408)
ln(INCOME)	- 0.348***	- 0.385***	- 0.253***	- 0.295***
	(0.098)	(0.095)	(0.085)	(0.105)
MALE	- 1.140***	- 1.005***	- 0.989***	- 0.859***
	(0.151)	(0.147)	(0.131)	(0.161)
BLACK	0.996***	1.331***	0.807***	1.014***
	(0.191)	(0.185)	(0.165)	(0.203)
N	799	799	799	799
Adjusted R^2	0.165	0.190	0.182	0.128

Notes
*** - significant at 1% level ** - significant at 5% level
* - significant at 10% level

TABLE II

ANALYSIS OF UNKNOWN FACTOR FOR EACH HAZARD

(standard errors in parentheses)

	AVIATION	HOME FIRES	AUTOS	CANCER
Constant	9.019***	3.111***	2.305**	11.336***
	(1.366)	(1.175)	(1.075)	(1.450)
ln(AGE)	- 0.290	- 0.084	0.434***	- 1.713***
	(0.196)	(0.169)	(0.155)	(0.208)
ln(SCHOOL)	- 0.843**	0.271	- 0.256	- 0.459
	(0.366)	(0.315)	(0.288)	(0.389)
ln(INCOME)	- 0.181*	- 0.052	- 0.054	0.045
	(0.094)	(0.081)	(0.074)	(0.100)
MALE	- 0.302**	0.165	- 0.047	0.336**
	(0.140)(0.145)	(0.124)	(0.114)	(0.153)
BLACK	- 0.269	- 0.661***	- 0.583***	- 0.385**
	(0.182)	(0.157)	(0.143)	(0.193)
N	799	799	799	799
Adjusted R^2	0.022	0.022	0.027	0.084

Notes

*** - significant at 1% level ** - significant at 5% level

* - significant at 10% level

TABLE III

ANALYSIS OF PERSONAL EXPOSURE FACTOR FOR EACH HAZARD

(standard errors in parentheses)

	AVIATION	HOME FIRES	AUTOS	CANCER
Constant	5.895***	9.480***	10.527***	4.713***
	(1.363)	(1.283)	(1.264)	(1.342)
ln(AGE)	- 0.464**	- 0.458**	- 1.153***	0.801***
	(0.196)	(0.185)	(0.182)	(0.193)
ln(SCHOOL)	- 0.004	- 0.625*	- 0.365	- 1.017***
	(0.365)	(0.344)	(0.339)	(0.360)
ln(INCOME)	- 0.153*	- 0.292***	- 0.088	- 0.202**
	(0.094)	(0.088)	(0.087)	(0.092)
MALE	- 0.312**	- 0.309**	- 0.456***	- 0.345**
	(0.144)	(0.136)	(0.134)	(0.142)
BLACK	0.632***	1.006***	0.602***	0.667***
	(0.182)	(0.171)	(0.169)	(0.179)
N	799	799	799	799
Adjusted R^2	0.034	0.098	0.081	0.085

Notes
*** - significant at 1% level ** - significant at 5% level
* - significant at 10% level

Q42 The following group of questions asks your opinions about four types of health hazards: commercial airplane accidents, household fires, automobile accidents, and stomach cancer.

For each of these hazards, please use a seven-point scale with "1" meaning you remain calm when thinking about it and "7" meaning you become nervous when thinking about it. Feel free to pick any number on the scale.

A. How do you feel when thinking about commercial airplane accidents?

Remain Calm 1 2 3 4 5 6 7 Become Nervous

And similarly for household fires, automobile accidents and stomach cancer.

Figure 1: **The "dread" question.**

Q43. Next, for each of the hazards, please tell me how informed you are about the risk and seriousness of each. For this use a seven-point scale with "1" meaning that you basically know nothing about the risk and seriousness and "7" meaning that you are well informed.

A. How informed are you about the risk and seriousness of commercial airplane accidents?

Don't know anything 1 2 3 4 5 6 7 Well informed

And similarly for household fires, automobile accidents and stomach cancer.

Figure 2: **The "unknown" Question**

Q44. Next, for each of these hazards, please tell me how much actual threat each poses to you personally. For this please use a seven-point scale with "1" meaning that you feel no personal threat and "7" meaning you feel a high personal threat.

A. How much threat do you personally feel from commercial airplane accidents?

No threat 1 2 3 4 5 6 7 High threat

And similarly for household fires, automobile accidents and stomach cancer.

Figure 3: **The subjective probability question**