

## **PUBLIC RISK PERCEPTION AFTER THE NUCLEAR ACCIDENT IN FUKUSHIMA: A CASE WITH UNIVERSITY STUDENTS**

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### **ABSTRACT**

This paper presents a comparative study of research conducted with university students before (03 to 05/2010) and after (06 and 07/2011) the accident in nuclear plants in Fukushima, Japan, provoked by the tsunami on March 11, 2011, with regards to risk perception associated with the use of nuclear energy.

### **1. INTRODUCTION**

In various areas of studies, there have been many researches and definitions of the concept of risk. Studies in social sciences have focused on the perception of risk, from an individual's perspective who perceives risky situations, emphasizing the influences of subjective facts (ethical, moral and cultural), both in actions and in decisions [1].

According to Lima [2], risk is associated with a group of technologies and activities, rather than not the number of losses that it causes. Besides that, the degree of knowledge about the event considered as risky can also influence its perception.

Studies results on perception of risk have helped in the explanation and anticipation of, sometimes as an opposition to, the acceptance of new technologies. Thus, the evaluation, the communication and the management of risk are absolutely essential disciplines when it comes to researches and development of new technologies [3].

The most recent event involving nuclear technology was the result of an earthquake, which registered 8.9 on the Richter scale, that provoked a tsunami that hit Japan on March, 2011, devastating coastal regions of the country. Seismic shocks affected the nuclear plant of Fukushima, and leaks of radioactivity were detected in the atmosphere, land and ocean.

This event might have affected public perception; therefore this study has as objective to compare the perception of risk in a university group (undergraduate and postgraduate), before and after the nuclear accident in Fukushima, Japan.

According to Slovic, Fischhoff & Lichtenstein [4], events that are likely to happen frequently are easier to be remembered than less frequent ones, as well as probable occurrences are easier to be imagined than improbable ones.

As indicated by Slovic [5], an accident in a nuclear reactor might bring immense social consequences if the public sees it as a presage for further possible catastrophic accidents.

## **2. RISK PERCEPTION**

Several areas of research have studied the concept and the term risk perception. Economics science tries to quantify it. In the engineering field, risk analysis is used to verify the impact of its actions in society. Epidemiology evolved when it included both the concept of risk and its factors, and the risk in the analyses of disease prevention. Studies about risk perception, carried out in social science, emphasize the individual's perspective in risky situations, taking into account many subjective factors that interfere not only in decision making, but also in ethics, morals and cultural factors, therefore guiding the actions and options of an individual [1].

As well as geography, sociology, political science, anthropology and psychology have contributed to the comprehension of how risk perception works. Geography has contributed with studies about the behavior of human before natural risks. Studies in anthropology and sociology have pointed out the interference of social and cultural factors of risk perception and acceptance, whereas, researches in psychology focus on the empirical studies about the processes of decision [3].

Therefore, risk perception is present in the population's day-to-day activities, enabling the individuals of this population to perceive risks that they encounter. This perception is influenced by individual and social values, which in turn, allows these individuals to simply analyze, manage and communicate risks (even if they are small, subjective, hypothetical, emotional and/or irrational). This way, individuals can make decisions and actions before these risks, although the decision or the action may not be the best or the correct one, but it is still individual.

Since the discovery of nuclear energy's potential, its use has been marked by accidents, such as the one that happened in the nuclear reactor at Chernobyl (1986), the one in the plant of Three Mile Island (1979), the accident with Cesium-137 in Goiania (1987), the latest accident in the plant of Fukushima (March, 2011), among others of smaller intensity; including the atomic bombs attacks in Hiroshima and Nagasaki (1945). This history of accidents and attacks not only stopped many ongoing projects, but also prevented others from being initiated.

When taking all these facts into account, the study of nuclear risk perception for the development of public politics and social communication system of risk is extremely important, which will help the acceptability of risk and consequently support the development and use of nuclear technology. This study is useful as well as its correct communication. The population needs to be informed in order for their knowledge of decision making and action taking to be properly founded based on serious information, so that people are clear about its real benefits and the risk of nuclear energy, since our fears in relation to the use of technology may be rooted in our social and cultural consciousness [8].

Weart [8] made the following observation: *"Nuclear energy was conceived in secrecy, born in war, and first revealed to the world in horror. No matter how much proponents try to separate the peaceful from the weapons atom, the connection is firmly embedded in the minds of the public"*, reinforcing the origin of the population's fear concerning the use of nuclear energy.

### **3. METHODOLOGY**

The methodology used for this research was based on the replication of parts of the questionnaire Boemer [9] presented as his Master's dissertation as of 2010, after the nuclear accident in Japan, so that we could compare both results and measure the impact the accident has had on the perception of nuclear risk among university students (undergraduate and postgraduate).

The forms were available on the Internet for students to complete it online in two periods:

1. From 03.31.2010 to 05.31.2010 (before the nuclear accident in Japan) [9]; and
2. From 06.23.2011 to 07.30.2011 (after the nuclear accident in Japan).

### **4. RESULTS AND DISCUSSION**

In the first period, the survey was available for 62 days [9] and we obtained a total of 224 respondents. In the second period, a total of 89 questionnaires were available for 38 days (39.5% of the initial sample).

The information was tabulated and analyzed as presented and discussed below:

#### **4.1. Profile of the Interviewees**

The interviewees profile is characterized as:

- They are aged between 18 and 60 years old, and most are aged between 21 and 30 years old (55% of population);
- The male-female ratio is well distributed (50% male to 49% female);
- Most are single (70%);
- Most are graduate students in public and private universities (66%); and
- Most study in the capital of São Paulo State (65%), Brazil, and the metropolitan region (13%).

#### **4.2. Risk Scale**

Respondents were asked to rank the activities below, using numbers from 1 to 10, with 1 being the least dangerous and the 10 the most dangerous.

**Table 1. Risk scale for certain activities (more dangerous)**

<i><b>MORE DANGEROUS (9-10)<sup>1</sup></b></i>		
<b>ACTIVITIES</b>	<b>2010</b>	<b>2011</b>
Depletion of the ozone	41%	55%
Greenhouse	25%	39%
Deforestation	25%	56%
Nuclear power plant	23%	39%
River pollution	22%	63%
Smoke	21%	47%
Cholesterol	12%	34%
Smoke emission	11%	28%
Air travel	10%	3%
Hydroelectric	9%	9%

1. Quotes with number 9 and 10, represents more danger in the activity.

**Table 2. Risk scale for certain activities (less dangerous)**

<i><b>LESS DANGEROUS (1-2)<sup>2</sup></b></i>		
<b>ACTIVITIES</b>	<b>2010</b>	<b>2011</b>
Air travel	81%	54%
Hydroelectric	44%	15%
Cholesterol	28%	2%
Smoke	15%	2%
Nuclear power plant	15%	9%
Smoke emission	4%	0%
Depletion of the ozone	4%	2%
Greenhouse	4%	2%
River pollution	3%	0%
Deforestation	3%	0%

2. Quotes with number 1 and 2, represents less danger in the activity.

Tables 1 and 2 show that there was a not very significant increase in relation to determination of risk regarding nuclear power plant, as well as an increase in risk perception of activities related to environment, such as the depletion of the ozone layer, greenhouse, pollution of rivers and deforestation.

Results of previous studies show that risks are perceived as less dangerous relating to the control and familiarity that can take on the risk [6].

Some authors believe society tolerates a range of activities evaluated by respondents as having very little benefit and risk [7].

### 4.3. Concern over nuclear power

Respondents were asked about their concern with nuclear power (how long and the motivation for this concern).

**Table 3. Concern over nuclear power**

<i>HOW LONG HAVE YOU CONCERNED?</i>		
<b>Concern</b>	<b>2010</b>	<b>2011</b>
Same hold	39%	29%
Greater than before	32%	52%
Lower than before	18%	8%
Don't care	11%	11%

The results show an increase of 20% in the concern with nuclear power after the Japanese accident. This factor was influenced by the catastrophic potential that was perceived after the accident in Fukushima.

When asked about the reason for this concern in 2010, most of the respondents pointed out issues related to lack of or access to the information. 71% of the respondents showed that their concern is the same or greater than before.

In 2011, the respondents mentioned, in most cases, that the accident at the plants in Fukushima influenced the way they see the use of nuclear technology; access to information provided by mass media post event was also identified as significant.

### 4.4. Associations with the term: nuclear power

The respondents were requested to write whatever came to mind with the expression nuclear energy.

**Table 4. Associations with the term: nuclear power**

<b>Keyword</b>	<b>2010</b>	<b>2011</b>
Nuclear power	41.01%	45.68%
Accidents / Japan	10.60%	43.21%
Radioactive wastes	10.60%	8.64%

The results presented in Table 4 indicate a word association with accident, bringing memories of the accident in Fukushima. However, the knowledge of the use of nuclear energy for electricity generation also grew.

In 2011, the interviewees were asked what comes to mind when they heard the expression. 45.68% responded with words related to energy production, 43.21% mentioned words related to accidents and what happened in Fukushima in Japan. In addition, 8.64% answered the question with words related to the issue of disposal of radioactive waste and concern with the safety of facilities.

Most respondents associated the use of nuclear energy as a source of energy production in a clean manner, but all reported great concern with the possibility of accidents and that special attention should be given to safety and disposal of nuclear wastes.

## 5. CONCLUSIONS

The data collected in 2011 compared to 2010 results show that there was an increased concern regarding the use of nuclear energy, while at the same massive access to information and knowledge also had a significant increase.

After the accident, part of the population that responded to the questionnaire sees nuclear energy as a source of accidents with catastrophic proportion, reducing not only their ability to tolerate but also live with the factor considered risky, in this case, nuclear energy.

The support and media coverage of the event provided quick access to the general public, with opinions from several sources, for and against nuclear power. Disclosure of prolonged or even irreversible damage, lack of control and containment of the leak, and the possible impact on future generations of the accident may have influenced the increased concern regarding the use of nuclear power, and influence the perception of increased risk factor of the nuclear reactor as dangerous.

The massive exploration of information sources overestimates some points when an issue is discussed right after an accident occurs, for example, events with proportion as big as the accident in Fukushima. However, it underestimates other risks that arise from the occurrence of the same type of accident. This can happen due to the lack of full comprehension of the issue, which needs to be addressed in advance.

Therefore, it is necessary to reconsider how information is disclosed to the population, and clarify the use of nuclear energy (its risks and benefits) to the public in general and also to the public who will form opinions and make decisions in the future [10].

The moment is delicate and programs of public acceptance must be re-planned in order to up-to-date the public before recent events involving the use of nuclear technology, clarifying the real impacts and consequences of the accident with the Japanese nuclear power plants.

For this reason, nuclear risk management should focus on maintenance and guarantee of the safety of plants and ongoing projects, aiming at the preservation and restoration of public confidence in countries that have or intend to continue their nuclear programs. The population in general tends to consider a risk factor less dangerous when they are able to trust the agent who controls such factor.

Confidence, clarity and transparency are factors that should be prioritized in public policies, aiming to get the population's support (in any situation) for the government's actions when it comes to nuclear energy.

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