LAY SEVERE WEATHER COMPETENCE – A PILOT STUDY ON BRAZIL, INDIA, AND GERMANY

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I. INTRODUCTION

In the United States, the wealthiest high-technology nation of the western world, natural hazards killed 24,000 people in a 20-year period (Mileti, 1999); floods, storms, tornadoes, hurricanes, earthquakes, and fire harmed 2 million US households per year and one-seventh of the US population felt threatened by natural hazards (Peek and Mileti, 2002). On a global scale, natural disasters killed 84,000 people each year over a 25-year period, and impacted 140 million people in a significant way (Peek and Mileti, 2002). As natural hazards cause short- and long-term emotional distress and trauma, disaster preparedness and response is a main social, political, and economic issue. In this context, weather knowledge, interest, and risk assessment of laypeople are key elements of severe weather warning efficiency. Munich RE recorded a rising number of events in the categories hydrology and meteorology (Fig.1).

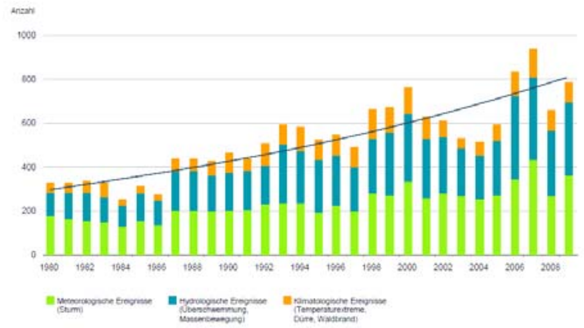

FIG. 1: Natural catastrophes 1980-2009 (Munich RE, 2010).

Reason enough for the first author to widen his research perspective on the environmental psychology of natural hazards (e.g. Keul et al., 2009; Keul and Holzer, 2013) to a comparison of different countries worldwide (Doswell, 2003). A cross-cultural perspective was expected to assess a more general and culture-sensitive picture of the strengths and weaknesses in national hazard warnings, preparedness, and response. However, it remained unclear whether a low-budget approach would succeed in spite of possible methodical, language, and organizational problems. Therefore, a pilot experiment was planned at the ECSS 2011 in Spain.

II. PRESENTATION OF RESEARCH

After initial contacts with international severe weather researchers, a three-area pilot study was done by the six authors in team-work on Brazil, India, and Germany. The international NASA lightning map (Jentoft-Nilsen, 2006, Fig.1) shows southern Brazil and eastern India as major convective areas with lightning flash frequencies over 20 per square km and year, whereas Germany falls below 5 flashes per square km and year.

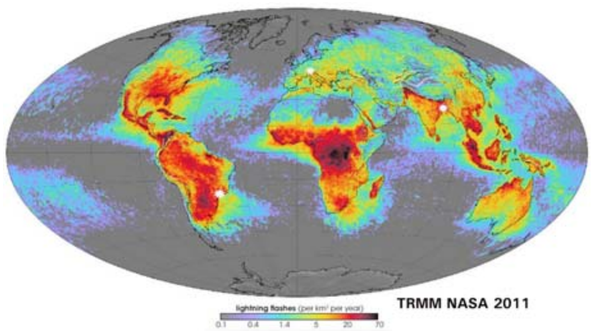

FIG. 2: NASA LIS-OTD lightning map 2006; 3 survey areas (stars).

From 1981 to 2010, weather-related events were the main natural disaster source for Brazil (88.8%), India (83.7%) and Germany (93.4%), according to EM-DAT, the International Disaster Database (2013). For Brazil and India, the most common hazard was floods (54.6%, 42.9%), while in Germany, storms triggered more impacts (57.4%).

Brazilian survey data came from Campinas, sea level 685 m, state of São Paulo. Campinas has about 1 million inhabitants living on an area of 801 square km. It is in the subtropical climate area, precipitation average 1,400 m, 70% during spring to summer time. Heavy rainfall and winds are common; the area is also tornado-prone (Candido, 2012). Urban expansion and deforestation outside legal regulations resulted in increased floods (Nunes, 2011; Castellano and Nunes, 2011).

Samples from India were collected mostly in mountainous Nagaland state, situated in the northeast part of India. It has a humid subtropical climate with mild summers. Heavy rainfall occurs during the monsoon months of June to August. The recorded average annual rainfall of the state ranges from 1,300-2,500 mm. This region is a catchment area for three major rivers of the region, namely

Brahhamputra and Barak rivers in India and Chindwin river in Mayanmar. The region suffers from landslide danger. Northeast India and adjoining Bangladesh shows a tornado cluster (Peterson and Mehta, 1981).

The German survey chose the Rosenheim (447 m a.s.l.), Bavaria, foothills north of the Alps, at the border of oceanic/humid and warm summer continental climate. The temperature maximum falls into July, shower and thunderstorm precipitation is high from late spring throughout summer. Tornadoes are possible (Dotzek, 2001).

The three countries are highly diverse with regard to climatic conditions, size and socioeconomic background of the population, preparedness and vulnerability.

Layperson questionnaires of the first author on severe weather and lightning were merged into a two-page questionnaire with items about media weather (report) interest/sources/legibility, basic weather knowledge, subjective risk assessment, preparedness, self-reported behavior, actual physical damage by weather events, and sociodemographic data. In India, an English version was used, in Brazil, a Portuguese translation, and in Bavaria, the German original.

III. RESULTS AND CONCLUSIONS

The street survey quota samples comprised 80 to 100 persons with a mean age between 36 and 39 years. The samples were gender-balanced. Household sizes were 1.5 to 3 adults and under 1 to 2 children. The Brazilian and Indian samples had a high-education bias (Tab.I). Single houses were more common in Brazil and India, multistorey dwellings in Bavaria.

Hazard	India	Brazil	Germany
sample (n)	100	104	80
mean age yrs.	35.8	37.2	38.8
age range yrs.	18-57	19-73	20-78
male %	50.0	50.0	51.2
female %	50.0	50.0	48.8
adults/household	2.6	2.2	1.5
children/househ.	2.1	0.3	1.1
basic educ.%	17.0	16.3	14.1
high educ.%	66.0	53.8	30.8
single houses%	52.0	68.3	20.5
multistorey h.%	21.0	2.9	50.0

TABLE I: Survey sample population characteristics.

FIG. 3: Landslide– subjective main risk at NE India (Sharma).

Weather interest ranged above 50% in all three countries (Germany 80%). Interest in media weather reports varied (India 31%, Brazil and Germany 53%). The main sources of meteorological information were TV/newspapers in India, TV/internet in Brazil, and internet/radio/TV in Germany. MET report legibility was rated medium by all samples. Subjective risk assessment (Tab.II) identified landslides as Indian top-feared risk (Fig.3), floods in Brazil (Fig.4), and tornadoes in Germany.

Meteorological lay knowledge –operationalized by definitions of high/low, cold front, tornado, and cloud names – was low in India (e.g. 83% knew no cloud names), medium in Brazil, high in Germany.

FIG. 4: Campinas flood – subjective main risk in Brazil (Nunes).

Hazards	India	Brazil	Germany
hurricane*	5.1	7.8	**7.6**
heat	3.7	6.1	4.5
landslide	**7.6**	**8.9**	6.2
hail	3.9	6.8	6.7
tornado	4.4	7.4	**8.1**
Flood	4.4	**9.1**	**7.8**
avalanche	3.2	5.9	6.4
lightning	5.2	7.4	5.5
snow	2.0	2.9	5.3
rainfall	5.6	7.1	5.1

TABLE II: Subjective risk of meteorological hazards (10-point Likert scale, 0=no, 10=high danger), mean values per survey area.
* "severe storm" in Germany

Recalled physical damage events (Tab.III) were sparse in India (11% storm, 9% flood), medium in Brazil (30% storm, 28% lightning) and in Germany (41% storm, 29% flood, 23% lightning).

Actual events	India	Brazil	Germany
lightning nearby	58.0	68.3	40.0
lightn. damage	4.0	27.9	22.5
flood damage	9.0	8.7	28.7
storm damage	11.0	29.8	40.5

TABLE III: Frequency of actual events, percentages per area.

Severe weather information (good: 25% India, 14% Brazil, 50% Germany) and preparation (good: 31% India, 7% Brazil, 24% Germany) show room for improvement (Tab.IV). Natural hazards insurance is not very common in Brazil.

Aware/prepared	India	Brazil	Germany
weather-exposed	58.0	67.3	35.0
(partly) prepared	83.0	45.2	78.8
(partly) insured	67.0	10.6	53.8

TABLE IV: Risk awareness and preparedness, percentages per area.

Meteorological interest or behavior did not correlate with higher education in Brazil and Germany. In India, higher-educated people were more weather-interested. In all three countries, general weather interest and media weather report interest were statistically related. In flood-risky São Paulo State, estimated flood risk correlated with local weather information and preparedness. Recalled physical weather-related damage did not produce higher attention or attribution effects.

Germans of higher age reported significantly more interest in weather, followed daily weather more closely, and had more often weather-hazard-insurances. In India, no age effects were noticed. In Brazil, older people also followed daily weather reports more closely.

What about gender effects? In Germany, female respondents reported more weather hazard fear. In India, more males reported a weather insurance. In Brazil, more females reported weather hazard preparation.

Although pilot study results with small survey areas in big countries and with an education bias in two countries should not be over-interpreted, this field experiment already produced several interesting findings:

1. Weather interest and information involvement did not show up as an education-based ″priviledge″, but depends on personal factors (and age in two countries). Even with low meteorological lay knowledge, as in India, media MET information is present for those who listen.

2. Lay weather risk assessment is no rational computation, but frightening ″dread risks″ (landslide, tornado, lightning) reach more emotional attention (Slovic, 2000). Also, recently publicized hazard events will be more available for a lay risk assessment (Oliveira and Nunes, 2007). Hazard awareness does not necessarily lead to better preparedness (disaster prevention, insurance etc.). To get maximum weather warning efficiency, preventive information has to be repeated via local media (NDIS, 2000).

3. As actual exposure to meteorological hazards is either low or not remembered (floods only 9% in India and Brazil), media severe weather information should address possible hazards and their prevention possibilities. The MET message should not be ″helplessness″ (Wilkins, 1985), but awareness and competence.

For the next round of the international lay weather competence survey, more researchers from different countries have expressed interest to take part, which will make the outcome of the project more structured and general.

IV. ACKNOWLEDGMENTS

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