ENHANCING THE EFFICACY OF HURRICANE ADVISORIES

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Surveys were administered to citizens in the Charleston, South Carolina region to better understand their knowledge of the physics behind hurricanes, and how best to convey the risks associated with hurricanes in National Weather Service advisories. Ideas initially considered included the use of graphics, the use of inverted strike probability maps, less use of undefined terms in NWS advisories, and the use of graphic and textual landmark references. The project also attempted to measure the publics understanding of probability. The survey had 45 questions which allowed us to determine the understanding and comprehension of 202 subjects in a variety of scenarios, and also allowed us to examine the varied comprehension of various ethnic, gender and income level groups.

93% of our subjects had experienced hurricane effects before, two-thirds had evacuated during prior hurricane warnings, and 70% lived in buildings, which had sustained some property damage. Surprisingly, despite their obvious awareness of hurricanes, over 57% of our sample did not know the definition of a hurricane warning, as documented in Table 1 below. This idea extends to other terms such as storm surge, etc.

Table 1 Hurricane warnings, as defined by subjects

Definitions	Percent of Subjects
Expected in 24 hours	43%
Expected in 36 hours	18%
Possible in 24 hours	9%
Possible in 36 hours	17%
Dont know	11%
No Answer	1%

55% of our sample did not realize the main threat from a hurricane in coastal areas was from storm surge, as documented in Table 2. Furthermore, most were unaware of the elevation of their residence, and hence had no clue as to their potential inundation for a particular storm surge depth. Half of all the subjects felt that the NWS overstates the dangers from hurricanes and most also did not have an evacuation plan in place.

Table 2 Subjects idea of greatest hurricane danger

Main danger	Percent of Subjects
Wind	29%
Storm Surge	47%
Rain-related flooding	6%
Tornados	12%
No Answer	5%

Demographic analysis was applied to understand which groups had the most difficulty with hurricane risks. Minority groups seemed to have the least understanding, probably due to lower income levels and lower educational backgrounds. Females seemed to better appreciate the risks than males, but young and old adults seemed to equally understand the risks.

Table 3 Demographic Factors with regard to greatest hurricane danger

Demographic Factor	Percent Correct
Male	42%
Female	53%
Under 46 Years Old	45%
Over 46 Years Old	45%
Caucasian	50%
African-American	25%
No College Education	37%
College Education	53%
Below $50000 Income	40%
Above $50000 Income	56%

53% did not understand that a decrease in the forward speed of a hurricane would increase the time spent by a hurricane over their location, causing an increase in the amount of rainfall experienced, as documented in Table 4. Additionally, over 32% did not understand that errors by NWS in forecasting the forward speed and direction of hurricanes would affect the time available for evacuation (i.e. increase or decrease). These results support our hypothesis that the public often does not understand basic scientific principles and this lack of understanding could cause them to ignore, misinterpret or underestimate the threat.

Table 4 Subjects opinion on the result of a decrease in hurricane speed

Predominate Effect	Percent of Subjects
Increased Wind Speed and Storm Surge	36%
Decrease in Total Rainfall	8%
Increase in Total Rainfall	47%
Less time under high winds	3%
No Answer	6%

We found that a large majority of the sample preferred a graphical approach to information dissemination in contrast to the text-based approach used in local NWS advisories. This was especially true in probability issues. Over 62% of the sample answered correctly, from a graphical map of the probabilities, that there was a 20% chance of the center of Hurricane Georges striking within 75 miles of Mobile, Alabama within 72 hours. This result was in striking contrast to only 25% getting the correct answer on a similar question using a copy of a text-based warning issued by the NWS for the probability of Georges striking Panama City, Florida. Also, in a comparison of a text-based wind advisory and a graphical wind advisory, 75% of the sample correctly interpreted the graphical advisory as opposed to 12% correctly interpreting the text-based product. Besides the expressed preference for the graphical approach the strike probability results strongly support the hypothesis that the public is better able to interpret the graphs versus the text products.

Demographic analysis was also applied to understand group interpretation of graphical and text warnings. Again, minority groups had more difficulty interpreting either graphical or text-based warnings, probably a result of income and/or educational levels, which also showed a difference in understanding. This indicates that a separate warning system may need to be developed to reach out to these groups, perhaps using media favored by low income or less educated groups.

Table 5 Demographic factors for text advisories

Demographic factor	Percent who understood
Male	28%
Female	22%
Under 46 Years Old	27%
Over 46 Years Old	25%
Caucasian	28%
African-American	7%
No College Education	22%
College Education	27%
Below $50000 Income	20%
Above $50000 Income	30%

Table 6 Demographic factors for graphical advisories

Demographic factor	Percent who understood
Male	65%
Female	58%
Under 46 Years Old	66%
Over 46 Years Old	56%
Caucasian	70%
African-American	25%
No College Education	54%
College Education	69%
Below $50000 Income	53%
Above $50000 Income	74%

We also found the use of reference marks, whether text or pictorial, aided in the dissemination of warnings. 64% expressed a preference for an advisory containing specific text informing the public of storm surge heights in relation to landmarks such Charlestons city hall. Pictorial references accompanied the text. These references can help increase the perceived risk by the people who reside in close proximity to the reference points. In contrast 13% preferred a copy of an NWS advisory that contained no reference points, either textual or pictorial. Although local weather service offices are currently limited to text-based warnings such as the Hurricane Local Statement, a combination of text and pictorial references seems most effective. Perhaps as an interim measure NWS personnel could make pictorial references available on the local NWS web site so that media could cut and paste these references into their weather forecasts. This would personalize the information, increase the perceived risk, and confirm the urgency for taking selfprotective action.

A small percentage of our sample expressed interest in Internet-based information dissemination. 7% felt the use of an Internet based system of information was very important, 8% found it moderately important, 33% unimportant, and 46% did not know. It seems logical that the preferred graphical approach would work well with an Internet approach especially since the use of the Internet is growing rapidly.

The results of the survey did not support the use of an inverted strike probability map (i.e. the probability of a hurricane missing a location versus the probability of a hurricane striking a location). 42% did not support this alternative while 37% felt it could prove useful. The chief concern expressed by many centered on possible misinterpretations of the graph since the information has historically been presented as the probability of a hurricane striking a location. Any attempt to use this method would require a large investiture in education to decrease any chance of the public misinterpreting the inverted probabilities.

In summary, this study has demonstrated some of the difficulty the public has with current NWS hurricane warnings, and examines some potential improvements, which would increase public appreciation of the risks involved. It is our intention to further explore methods to enhance public understanding of the various dangers which hurricanes pose.

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