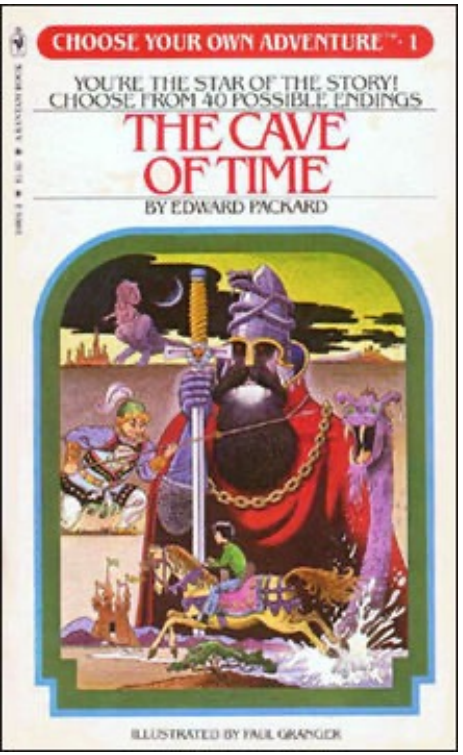
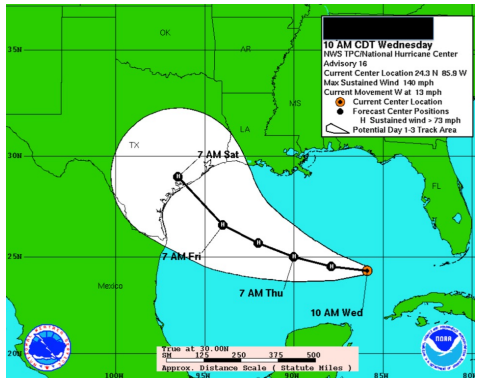
Thinking Critically About Uncertainty, Visual Representations, and Models in the Context of Emergency Management





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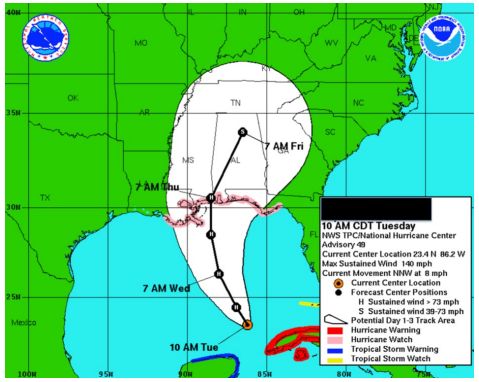

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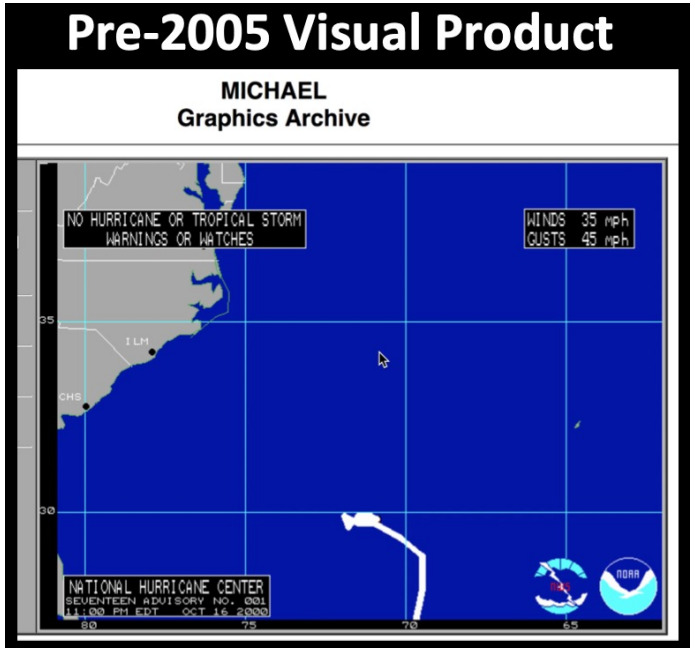
Pre-2005 Visual Product



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ARTICLES

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"A 30% Chance of Rain Tomorrow": How Does the Public Understand Probabilistic Weather Forecasts?

Gerd Gigerenzer,[1]* Ralph Hertwig,[2] Eva van den Broek,[1] Barbara Fasolo,[1] and Konstantinos V. Katsikopoulos[1]

The weather forecast says that there is a "30% chance of rain," and we think we understand what it means. This quantitative statement is assumed to be unambiguous and to convey more information than does a qualitative statement like "It might rain tomorrow." Because the forecast is expressed as a single-event probability, however, it does not specify the class of events it refers to. Therefore, even numerical probabilities can be interpreted by members of the public in multiple, mutually contradictory ways. To find out whether the same statement about rain probability evokes various interpretations, we randomly surveyed pedestrians in five metropolises located in countries that have had different degrees of exposure to probabilistic forecasts—Amsterdam, Athens, Berlin, Milan, and New York. They were asked what a "30% chance of rain tomorrow" means both in a multiple-choice and a free-response format. Only in New York did a majority of them supply the standard meteorological interpretation, namely, that when the weather conditions are like today, in 3 out of 10 cases there will be (at least a trace of) rain the next day. In each of the European cities, this alternative was judged as the least appropriate. The preferred interpretation in Europe was that it will rain tomorrow "30% of the time," followed by "in 30% of the area." To improve risk communication with the public, experts need to specify the reference class, that is, the class of events to which a single-event probability refers.

KEY WORDS: Cultural differences; risk communication; single-event probabilities; weather forecasts

1. INTRODUCTION

Predicting weather is an age-old problem of statistical inference. Harvesting, warfare, and outdoor sporting events depend on it. Before the Grand Prix, one of Ferrari's most-discussed decisions is which weather forecaster to hire, because reliable forecasts are key to choosing the right tires—and to winning the race. Over most of human history, forecasts of precipitation (rain or snow) were given in a deterministic form such as "It will rain tomorrow," sometimes modified by "it is likely." In the mid-20th century, however, the advent of computers turned forecasting into a probabilistic science (Shuman, 1989) and later influenced the way forecasts were communicated to the public. In 1965, American laypeople became the first to be exposed to probabilities of precipitation in mass media weather forecasts (Monahan & Steadman, 1996).

But how does the public understand a quantitative probability of rain? In 1980, Murphy *et al.* reported that the majority of 79 residents of Eugene, Oregon, mostly college students, "misunderstood" what "a precipitation probability forecast of 30%" means. The authors concluded that the real cause of the students' confusion was not a misunderstanding of probabilities *per se*, but rather of "the event to which

[1] Max Planck Institute for Human Development, Berlin, Germany.
[2] University of Basel, Basel, Switzerland.
* Address correspondence to Gerd Gigerenzer, Max Planck Institute for Human Development, Lentzeallee 94, 14195 Berlin, Germany; gigerenzer@mpib-berlin.mpg.de.

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Misinterpretations of the "Cone of Uncertainty" in Florida during the 2004 Hurricane Season

BY KENNETH BROAD, ANTHONY LEISEROWITZ, JESSICA WEINKLE, AND MARISSA STEKETEE

Rigorous pretesting, including insights from social science, could improve hurricane forecast graphics aimed at the general public.

Societies' ability to cope with natural hazards such as hurricanes is mediated by many factors, including socioeconomic constraints (Diaz and Pulwarty 1997; Peacock et al. 1997), cultural preferences (Douglas and Wildavsky 1982; Hewitt 1983; Whitehead 2003), demographic patterns (Pielke and Landsea 1999; Pielke and Pielke 1997), technological and scientific advances (Rappaport and Simpson 2003), and the communication and subjective interpretation of probabilistic information (National Research Council 2003; Loewenstein et al. 2001; Kahneman et al. 1982; Murphy et al. 1980). This article focuses on media and public interpretations of the National Hurricane Center's (NHC's) "cone of uncertainty"[1] ("COU"), a hurricane forecast graphic that circulated widely in Florida during the active 2004 Atlantic hurricane season (1 June–30 November), and concludes with a broader discussion of hurricane forecast graphics from the perspective of risk communication theory.

The cone of uncertainty is only one piece of information that may be used in an individual's decision-making process; thus, no claims of direct causality regarding evacuation behavior or other public responses

[1] Although the image is officially referred to as the "Tropical Cyclone Track and Watches/Warning," in interviews and by the media it has been given several different titles (to be discussed later). For the purpose of this paper we refer to it as the "NHC cone of uncertainty," unless otherwise specified.

AFFILIATIONS: Broad—Rosenstiel School of Marine and Atmospheric Science, and Center for Ecosystem Science and Policy, University of Miami, Miami, Florida, and Center for Research on Environmental Decisions, Columbia University, New York, New York; Leiserowitz—School of Forestry and Environmental Studies, Yale University, New Haven, Connecticut, and Center for Research on Environmental Decisions, Columbia University, New York, New York; Weinkle—Center for Research on Environmental Decisions, Columbia University, New York, New York; Steketee—Rosenstiel School of Marine and Atmospheric Science, University of Miami, Miami, Florida
CORRESPONDING AUTHOR: Kenneth Broad, University of Miami-RSMAS, 4600 Rickenbacker Causeway, Miami, FL 33149
E-mail: kbroad@rsmas.miami.edu

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