UPDATED: June 17, 2014

This is an expanded version of our original June 3 commentary. Updates are highlighted below.

Quite a few media outlets covered our PNAS article "Female hurricanes are deadlier than male hurricanes":
http://www.pnas.org/content/early/2014/05/29/1402786111.abstract
In some of the media stories, there appear to be misunderstandings based on the statistical approach employed in this peer-reviewed paper and the nature of the dataset. Here are our responses.

1. **All-Female Storms Before 1979:** We are of course aware that all hurricanes had female names from 1953 through 1978. In 1979, they began alternating the gender of the names. However, our analysis primarily focused on the femininity-masculinity of names, not only on male/female as a binary category. Even during the female-only years, the names differed in degree of femininity (compare two female names: Fern, which is less feminine to Camille, a rather feminine name; or Ione compared to the more-feminine Diane). When we model the fatalities of all hurricanes since 1950 using their names' *degree of femininity*, the interaction between name-femininity and damage is statistically significant. That is a key result. Specifically, for storms that did a lot of damage, the femininity of their names significantly predicted their death toll.

Update June 17: We show the robustness of the finding even in the post-1979 hurricane data, together with analyses of male-female (binary gender) as predictor and other model variations here.

Is this a statistical fluke? In some articles, Jeff Lazo says, "It could be that more people die in female-named hurricanes, simply because more people died in hurricanes on average before they started getting male names." But no, that is not the case according to our data and as reported in the paper. We included elapsed years (years since the hurricane) in our modeling and this did not have any significant effect in predicting fatalities. In other words, how long ago the storm occurred did not predict its death toll.

What's more, looking only at severe hurricanes that hit in 1979 and afterwards (those above $1.65B median damage), 16 male-named hurricane each caused 23 deaths on average whereas 14 female-named hurricanes each caused 29 deaths on average. This is looking at male/female as a simple binary category in the years since the names started alternating. So even in that shorter time window since 1979, severe female-named storms killed more people than did severe male-named storms.

2. **Direct and Indirect Deaths:** Another question raised was whether it's appropriate to look at both direct and indirect deaths. Please note that many of NOAA's monthly weather reports that we used to obtain fatality data do not distinguish between direct and indirect categories. Direct and indirect deaths are often grouped together. The issue

of indirect deaths has been addressed here: http://www.slate.com/articles/news_and_politics/explainer/2012/10/hurricane_sandy_how_to_count_the_fatalities.html That article reads in part: "Fatal car accidents caused by torrential rains or flooding are indirect deaths, but storms can also be blamed for so-called 'natural' deaths." Deaths due to car accidents caused by washed out roads, or fires started by downed power lines, or heart attacks or other adverse health events that result from the storm may reflect preparedness. We believe these deaths should count and are appropriately included in the dataset.

3. **Hurricane names versus other factors that affect preparedness:** We cannot claim (nor did we claim) that gendered naming is more important than other factors. Other factors certainly matter, as well. But that doesn't mean we should ignore the apparent impact of the femininity of the names. Meteorologists and hazard communication specialists have called for more attention to social science factors that predict how people respond to hazard warnings. Implicit biases represent an understudied factor that makes a difference.

4. **Appropriateness of the experiments' context and respondent populations:** The goal of our experiments, indeed of any experiment, is to control for other factors in order to isolate the role of a specific variable, in this case the gender of the hurricane's name. In several of our experiments, the research participants were people from around the U.S., ages 18-81. In other experiments, they were University of Illinois students. The findings of the experiments were completely consistent regardless of the respondent population. That said, we do not claim that the effect of name-gender found in our experiments will be the same as the size of the effect you would obtain in the field with coastal residents in the path of actual storms. The gender-name effect may be weaker in those real-world contexts. Alternatively, it could be accentuated in a setting in which people are dealing with uncertainty and are under considerable stress. This is a question worth investigating further. Our findings represent a first step.

5. **Modeling of the data:** We noted a blog post by an "economist", who improperly modeled the data using basic ordinary least squares (OLS) regression. However, the data in our article were modeled using sophisticated count models. Appropriate adjustments were made to standard errors for extra-dispersion in the data, and goodness-of-fit tests were comparatively applied to the models. What this told us is that there appears to be a statistically meaningful relationship between hurricane damage and femininity of name (for severe storms). Of course any model, significant or not, allows for the possibility of being mistaken. It is a probabilistic relationship. However, it is critical to apply the correct modeling technique when modeling count data such as fatalities. OLS regression is not an appropriate method. This was explained in detail in our paper.

Update June 17: We also noted a few very simple efforts to correlate masculinity-femininity of name with death toll in a subset of the data, without controlling for any other factors, and then drawing conclusions about whether the effect holds (e.g., on

Slate.com). For multiple reasons, this type of approach is quite misleading. Appropriate analyses show that keeping versus deleting data from Hurricane Sandy does not change the conclusions, as claimed in some commentaries. They can be found here.

6. **Policy Implications:** We are not suggesting that policy be changed based on one study. As we indicated to journalists who asked, we will leave such decisions to policy experts. What we are suggesting is that this finding merits further investigation. Our goal is to add to the knowledge in this area and to the ongoing policy conversation.

Thank you,

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